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NRL Instruction Book No. 25

INSTRUCTIONS FOR ASSEMBLY, INSTALLATION AND MAINTENANCE OF RADIO RECEIVING HUTS

April 1960

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U. S. NAVAL RESEARCH LABORATORY
Washington, D.C.

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SECTION I

INTRODUCTION

- 0 -

The electronic facilities covered by this Instruction Manual are intended for the reception of scientific information from earth encircling satellites.

Each of the facilities is complete (except for basic power supply) and consists essentially of a suitable semi-permanent but readily transportable enclosure, hereinafter designated as a "hut", containing all the necessary electronic equipment for the accomplishment of its particular mission, including heating (and in some cases cooling) to provide for comfortable habitation of the operating personnel.

The facilities are universal with respect to their possible locations. All directional antennas are carried on and by the respective huts and are completely rotatable. For unidirectional reception, vertical antennas with counterpoises are furnished, designed and suitable for mounting closely adjacent to the respective huts and provided with all mounting and cabling appurtenances.

However, in order to simplify and expedite shipment, as well as to provide the maximum protection for delicate electronic devices, most of the various pieces of equipment have been removed from their normal position, carefully boxed individually and stowed within the huts. Thus, when a hut is received, it will be found to contain all material and equipment required for establishing the facility. However, it will be realized that this method of shipment, while to the best interest of all concerned, as well as the equipment, will require a certain amount of installation work, although such work should not require in excess of a working day for several qualified men.

SECTION 2

GENERAL DESCRIPTION OF FACILITIES

- 0 -

2.1 PURPOSE

The purpose of the facilities covered by this Instruction Manual is to provide means of the utmost flexibility for the reception of signals emanating from an orbiting satellite and to permit the recording of scientific intelligence carried by such signals in a manner that will permit of its analysis and interpretation at a later date. Because of the nature of the signals, equipment possessing the very maximum in sensitivity, accuracy and reliability is essential.

2.2 THE ELECTRONIC EQUIPMENT

In order to meet these requirements, two complete but separate and distinct receiving systems are provided, each with its own directional and rotatable antenna array. Two receivers possessing high sensitivity and quite low noise figures are provided, each consisting of a standard high-frequency receiver preceded by a VHF amplifier/converter unit. In the interest of additional reliability, the converters are provided in duplicate with means for using either on each receiver.

For recording any received data for future analysis, a dual-channel high-fidelity tape recorder is furnished with means for switching it to the output of either receiver.

In the event that time might be of importance in the analysis of received data, a time code generator is provided that will permit the continuous recording of time, accurate to a fraction of a second, on one channel of the recorder tape. To permit a higher order of time accuracy to be maintained, means are provided for the reception of time signals from available high-frequency stations, such as WWV.

This is accomplished by supplying an efficient vertical monopole antenna with a counterpoise system, and means for switching it to the input of one of the high-frequency receivers.

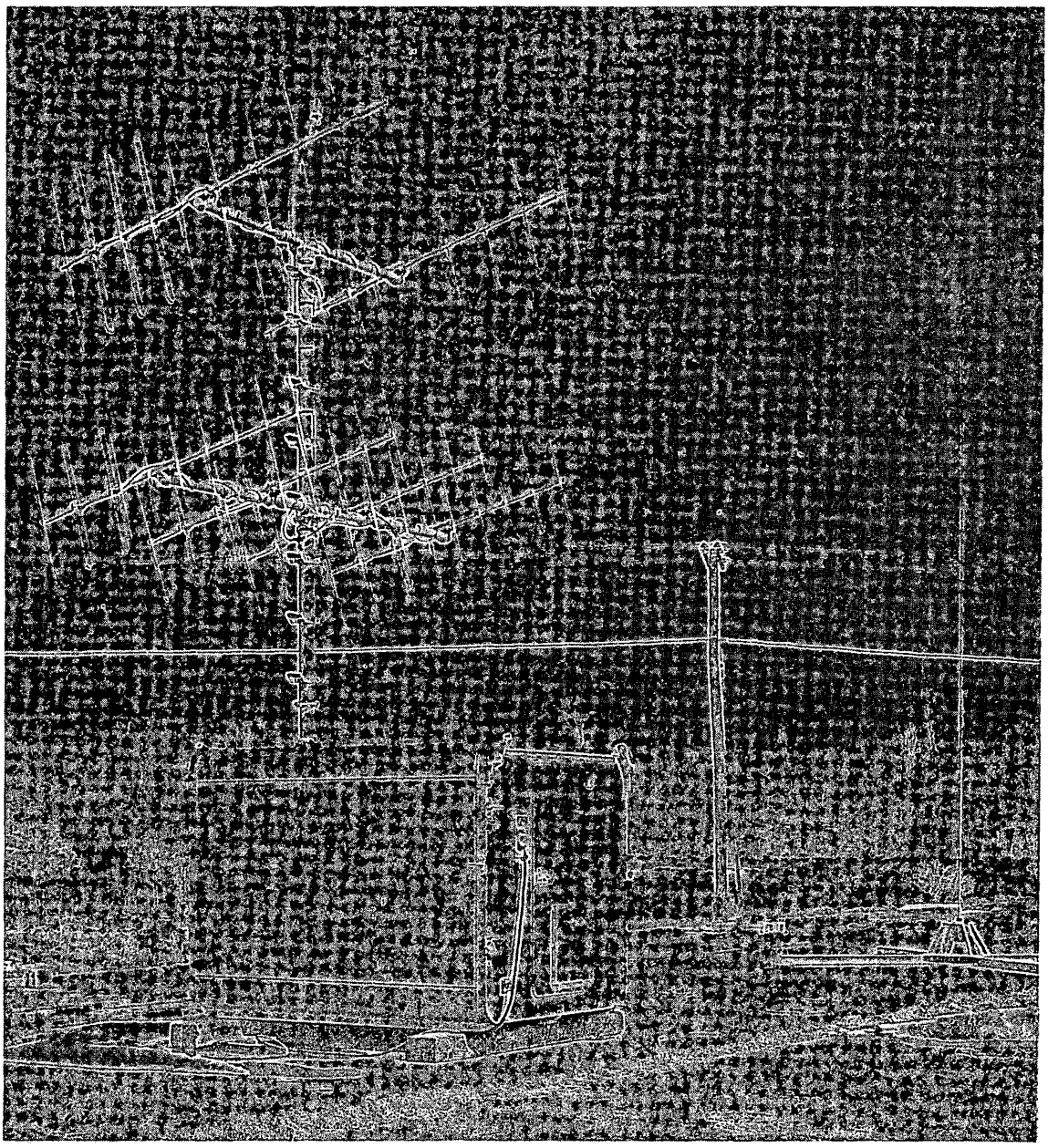

Figure 1 - The Complete Installation

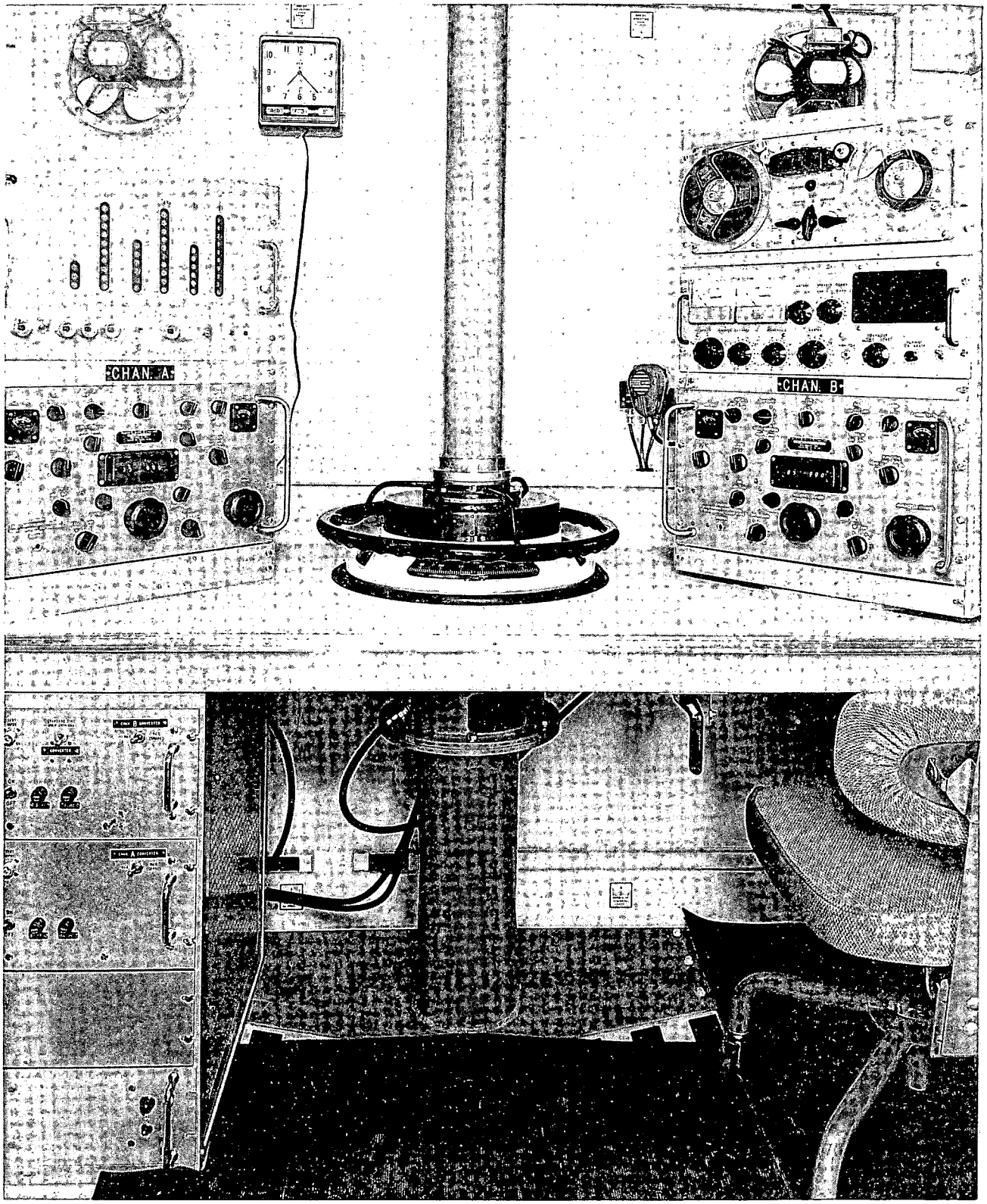

Figure 2 - The Complete Equipment

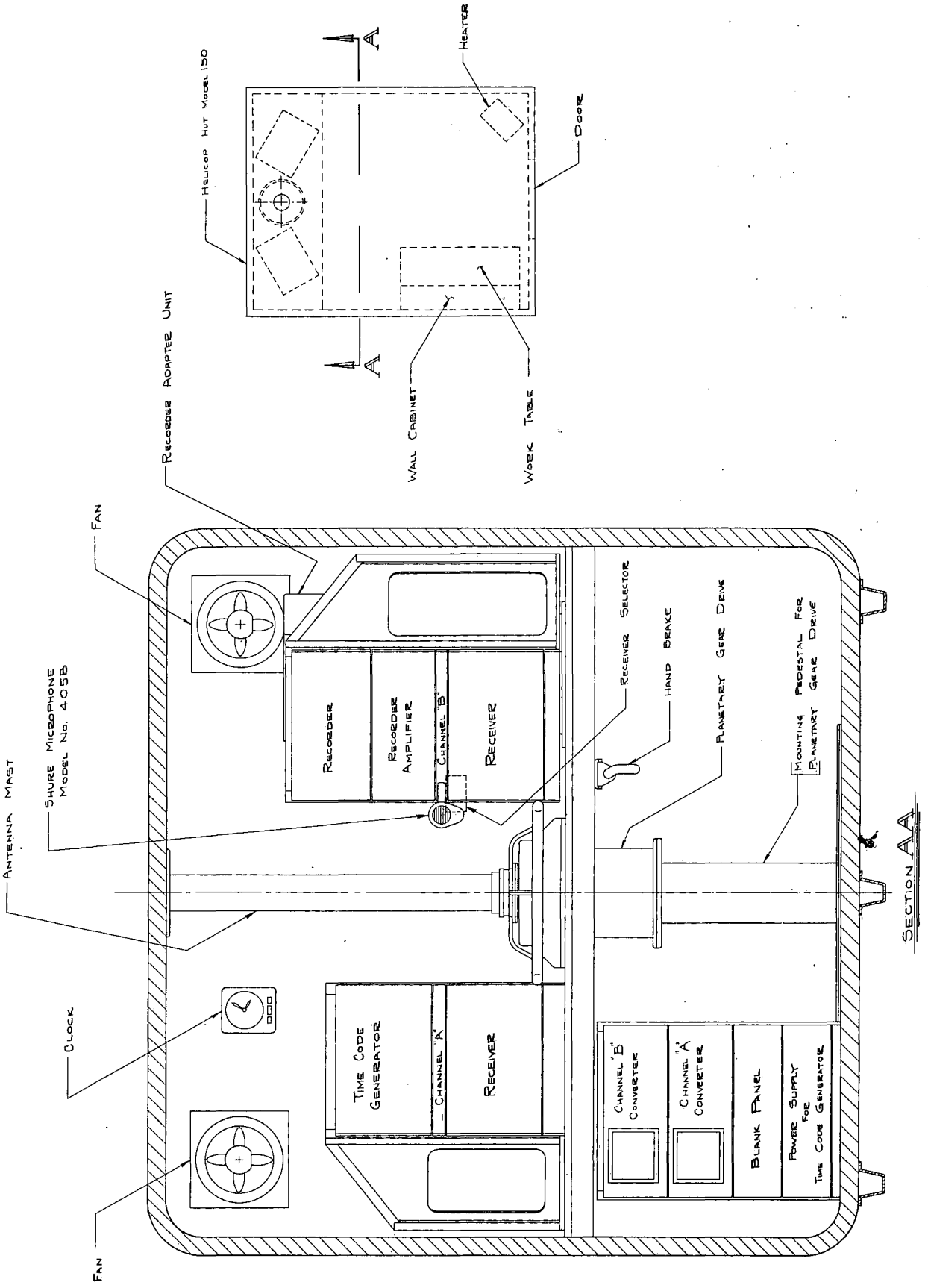

Figure 3 - Placement of Equipment

2.3 THE PHYSICAL ARRANGEMENT

Figure 1 is a view of the complete receiving facilities as installed in the field. In this view can be seen the operating hut with the two VHF antenna arrays mounted on their rotatable mast. Beside the hut may be seen the HF vertical monopole or whip antenna, surrounded by its counterpoise.

Figure 2 is an interior view of the operating hut taken from the door looking toward the operating table. Here may be seen, in the center of the operating table, a handwheel for rotating the two VHF antenna arrays, with an azimuth scale below it. Extending through the overhead of the hut is the rotatable mast on which the VHF antenna arrays are mounted, while below the table is a pedestal containing reduction gears introduced between the handwheel and the mast. A handle for setting a hand brake on the arrays is shown to its right.

On either side of the operating table are shown the various items of electronic equipment, mounted in racks. The first two units on either side of the antenna handwheel are two HF radio receivers employed as IF/AF amplifiers for VHF reception by using VHF converter units ahead of them.

Above them to the left is a Time Code Generator for generating accurate time signals for recording on magnetic tape while to the right is a tape recorder with its amplifier/power unit between it and the receiver.

Below the operating table at the extreme left is a three-tier rack containing, in the first two compartments, duplicate converters with their power units for the two receivers while the lower compartment houses the power unit for the Time Code Generator.

Posture chairs (not shown) are provided for two operators, as well as a small work table and a locker for keeping stationery, spare parts, etc. located to the left as one enters the door and also not shown in Figure 2. A 3 KW electric heater is provided just inside and to the right of the door. This is thermostatically controlled to maintain a uniform temperature in the hut. Figure 3 is a plan view of the interior of the hut together with a section view showing the location of the various pieces of equipment not shown in Figure 2.

In addition to the facilities enumerated above, one of the huts destined for a tropical location will be provided with a sun canopy and an air conditioning unit.

SECTION 3

LIST OF MATERIAL FURNISHED

- 0 -

3.1 BASIC COMPONENTS

Table I shows a list of the basic material furnished in and with each hut.

TABLE I

BASIC MATERIAL

-0-

Item #	Description	Quantity
1	Antennas (Channel A) 10-Element Yagi	2
2	Antennas (Channel B) 10-Element Yagi	4
3	Antenna Mast - Lower Section	1
4	Antenna Mast - Middle Section	1
5	Antenna Mast - Upper Section	1
6	Antenna Mast Jib Pole	1
7	Cross Arm - Upper - Complete	1
8	Cross Arm - Lower - Middle Section	1
9	Cross Arm - Lower - End Sections	2
10	Whip Antenna in 3 Sections each approximately 7 feet long	1
11	Whip Antenna Mounting Base with Insulator	1
12	Whip Antenna Mounting Legs	4
13	Antenna Parts Box	1
14	Radio Receiver - Type R-390A/URR	1
15	Radio Receiver - Type R-390A/URR	1
16	Tape Recorder - Magnecord Model PT6BA2HZ	1
17	Tape Recorder Amplifier - Magnecord Model PT6-BN	1
18	Time Code Generator - EECO Model Z-19135	1
19	Time Code Generator Power Unit - EECO Model Z-19263	1
20	Converter Assembly (Channel A)	1

Item #	Description	Quantity
21	Converter Assembly (Channel B)	1
22	Microphone with cord and plug - Shure Model 405B	1
23	Recorder Tape Reel	1
24	Recorder Tape (Amount varies with each shipment)	
25	Calendar Clock - Lux type (Omitted when Item 26 is furnished)	
26	Clock - Navy Standard (8-day) (Omitted when Item 25 is furnished)	
27	Power Cable - Tyrex 3-wire 600 volt (Length required)	
28	Power Cable Connector - MS-3106E-32-17S	1
29	RF Cables(# 10, 11, 12, 13, 14, 19, 20, 37) with connectors - Total number 8	1 Set
30	Chairs - Posture Type	2
31	Heater, Electric, 3kw - Chromalox (with mounting base)	1
32	Instruction Books	1 Set
33	Spare Tubes, Fuses, etc.	1 Set
34*	Channel A Equipment Rack	1
35 *	Channel B Equipment Rack	1
36*	Converters/Time Code Generator Power Unit Rack	1
37*	Recorder Adapter (Mounted on Channel B Rack)	1
38*	Receiver Selector Unit	1
39*	Exhaust Fans - Rotron	2
40*	Thermostat - Chromalox	1
41*	Antenna Drive System - Complete with gearing, handwheel, azimuth scale, etc.	1
	The following items for one installation only:	
42	Air Conditioner - GE Type	1
43	Canopy Material (For sun canopy)	1 Set

* These items are shipped in place and not packed separately.

3.2 INSTALLATION MATERIAL

Table 2 shows the material furnished to make and complete an installation. This material is contained in the Antenna Parts Box (Item 13 of Table I).

TABLE 2

INSTALLATION MATERIAL

- 0 -

1 Tool Box
2 Safety belt and strap
3 Block and Tackle
4 Sling
5 Box of 18 stakes
6 Coil of wire, 600 feet of #12 bare copper
7 Cardboard box containing bolts
  (a) Bag #1 3/8-16 x 1 3/4" long bolts, 28 enclosed
  (b) Bag #2 3/8-16 x 1 1/4" long bolts, 30 enclosed
  (c) Bag #3 1/2-13 x 1 1/2" long bolts, 28 enclosed
  (d) Box of 10-32 x 1/2" long binder head machine screws
  (e) Envelope containing 16 ground lugs
  (f) Electrical tape, 3/4" wide, 4 rolls
  (g) Tube Dow Corning Silicone
  (h) Tubes of grease (2)
  (i) Tube of caulking compound

3.3 TOOLS

Table 3 shows the tools furnished in the Tool Box (Item 1 of Table 2)

TABLE 3

TOOLS FURNISHED

- 0 -

Crescent wrench 12"
Crescent wrench 10"
Crescent wrench 8"
Box wrench 7/8"-3/4"
Box wrench 11/16" - 5/8"
Box wrench 9/16" - 1/2"
Screwdriver 8"
Screwdriver 4"
Screwdriver 2"
Screwdriver, Phillips Head 3"
Screw starter 6"
Screw starter 3"
Allen wrench, hex, 5/16" flats (2)
Allen wrench, hex, 3/16" flats (2)
Allen wrench, hex, 1/8" flats (2)
Wrench, Spintite, hex, 7/16" flats
Pliers
Carpenters hammer
Brake adjusting tool
Flashlight
Alemite grease gun
Caulking gun
Crimping tool for wire lugs

3.4 SPARE PARTS

Table 4 shows the spare parts furnished (Item 33 of Table I). Tube spares are based on 25% of each type but not less than 2.

TABLE 4

SPARE PARTS

- 0 -

SPARE TUBES

Tube Type	No. of Spares	Tube Type	No. of Spares
OA2	2	6AK6	2
OA3	2 - 1	6AL5	2
3TF7	4 - 0	6AQ5	2
5UG4	2	6BA6W	3
5Y3	2	6BQ7A	2 - 1
6AK5W	2	6C4	2 - 1

SPARE TUBES (Contd.)

Tube Type	No. of Spares	Tube Type	No. of Spares
6CB6	2 - 1	26Z5W	2
6DC6	2	417A	2
6J6	2	5687	2 - 1
6SJ7	2 - 1	5693	2 - 1
6Y6	2	5814A	4
12AT7	2	5879	2
12AU7	Use 5814A)	5963	10
12AX7	2	5965	10 - 1
12AY7	2 - 1	6080	2

SPARE FUSES AND MISCELLANEOUS ITEMS

Item	For Use In	Spares
Fuse, 3A, slow blow	Receivers	5
Fuse, 0.25A	Receivers	5
Fuse, 0.125A	Receivers	5
Fuse, 3A, 8AG-3	Converters	5
Fuse, 5A, 3AG-5	Code Generator Power Unit (F1)	3
Lamp, dial, 6V	Receivers	1
Lamp, glow	Receivers	1
Relay	Code Generator (K1)	1

3. 5 INSTRUCTION BOOKS

Table 5 shows the Instruction Books furnished (Item 32 of Table I). They cover the individual electronic units in detail.

TABLE 5

INSTRUCTION BOOKS

- 0 -

Equipment	Instruction Book, Drawing, Etc.
Radio Receiver	Technical Manual TM 11-856A for R-390A/URR
Recorder and Recorder Amplifier	(1) Instruction for Operating the Magnecorder PT63-A Tape Recorder Mechanism (2) Instruction Manual for the Magnecord PT6-BN Binaural Recording and Playback Amplifier (3) Magnecord Technical Bulletin No. 136R. D. (4) Magnecord drawing Binaural Recorder and Playback Amplifier 11B92D45G.
Time Code Generator	Instructions for Code Generator Z-19135 and Power Unit Z-19263, in EECO manual for ZA-19581.
Yagi Antenna	TACO Form 1609, "Coaxial Stacking Lines" (1 sheet).

SECTION 4

SIZES, WEIGHTS AND POWER REQUIREMENTS

- 0 -

4.1 SIZES

The enclosures (huts) require a mounting (base) area of approximately 12 x 14 feet. The huts proper are 80 x 100 inches; the additional space being required for guying. The height (to their roof tops) is approximately 6 1/2 feet. For the one Tropicalized hut this height is increased by eight inches by the sun canopy.

The rotatable antennas extend approximately 12 feet above the roof of the huts.

In addition to the land required for the huts, an additional area approximately 70 feet in diameter is required for the circular counterpoise systems for the vertical (whip) antennas. These antennas are approximately 25 feet in height and are entirely self supporting.

4.2 WEIGHTS

The huts, complete with all equipment installed (but without operators) weight approximately 2600 pounds. The tropicalized hut, because of the addition of the sun canopy and air conditioning unit, weighs approximately 400 pounds in excess of this figure.

The shipping weights of the huts, with all equipment packed in individual boxes and stowed within,is approximately 4,075 pounds. For the tropicalized hut, the shipping weight will approximate 4800 pounds.

4.3 POWER REQUIREMENTS

All the equipments in the huts are suitable for operation from a rated 120/240 volt, 50/60 cycle single-phase power source. Table 6 below shows the maximum power and current requirements for a complete installation, as well as a break down of similar requirements for each unit or equipment involved.

These data are based on operation at exactly 120/240 volts and 60 cycles. At higher or lower voltages the power might be expected to vary proportionately. No data is available for 50-cycle operation but it is expected that the power requirements will be slightly higher than for 60 cycles at the same voltage.

The various equipments are so connected to the respective sides of the three-wire power system as to make the current carried by the neutral wire relatively light.

TABLE 6

POWER REQUIREMENTS

Unit	Amps	Watts	P.F.
Complete hut, all units energized including heater and fans	26.2	4,526	97.6%
Complete hut, all units energized except heater	13.7	1.526	92.8%
Heater at 240 volts	12.5	3,000	100.0%
Lights (4 at 75 watts each)	2.5	300	100.0%
Fans, per unit (2 installed)	0.25	25	83.4%
Receivers, per unit (2 installed)	1.025	118	96.0%
Converters per tray of 2 units (2 installed)	1.265	144	94.8%
Time Code Generator	3.95	450	95.0%
Recorder and Amplifier (recorder inactive)	1.172	121	86.2%
Recorder and Amplifier (recorder on "record")	1.97	218	92.2%
Recorder and Amplifier (recorder on "rewind")	2.175	202	77.5%

NOTE: The maximum power required for the tropicalized hut will be the same as shown or approximately 600 watts less, inasmuch as it is assumed that the Air Conditioner and Heater would not be operating simultaneously and the latter requires approximately 600 watts more power than the Air Conditioner.

SECTION 5

ELECTRON TUBE COMPLEMENT

- 0 -

5.1 TUBES BY INSTALLATIONS

The total number of electron tubes by type and number of each type required for a complete installation is shown in TABLE 7.

TABLE 7

TUBES BY INSTALLATION

Tube Type	Number	Tube Type	Number	Tube Type	Number
OA2	3	6BQ7A	4	12AY7	1
OA3	4	6C4	6	26Z5W	4
3TF7	2	6CB6	4	417A(5842)	4
5U4G	1	6DC6	2	5687	1
5Y3	4	6J6	1	5693	1
6AK5W	4	6SJ7	4	5814A	14
6AK6	6	6Y6	4	5879	4
6AL5	2	12AT7	4	5963	39
6AQ5	4	12AU7	1	5965	39
6BA6W	12	12AX7	2	6080	2

TOTAL = 183

5.2 TUBES BY EQUIPMENTS

The electron tubes for each equipment of an installation, by type and number required, are shown in TABLE 8 below.

TABLE 8

TUBES BY EQUIPMENTS

R-390A/URR Receiver	Tapetone Converter	Converter Power Unit	Recorder & Amplifier	Time Code Generator	Generator Power Unit
1 - OA2	1 - 6BQ7A	1 - OA3	1 - 5U4G	2 - 6AL5	1 - OA2
1 - 3TF7	1 - 6CB6	1 - 5Y3	4 - 6AQ5	1 - 6J6	1 - 12AY7
2 - 6AK5W	1 - 12AT7	1 - 6SJ7	1 - 12AU7 (5814)	1 - 5687	2 - 6080
					4
3 - 6AK6	1 - 417A	1 - 6Y6	2 - 12AX7	1 - 5693	
6 - BA6W	4	4	4 - 5879	39 - 5963	
3 - 6C4			12	39 - 5965	
1 - 6DC6				83	
2 - 26Z5W					
7 - 5814A					
26					

SECTION 6

DETAILED DESCRIPTION OF FACILITIES

6.1 THE HUTS

6.11 General Description

Each facility is provided with an operating enclosure or hut containing all the necessary electronic equipment and space for two operators. These enclosures are commercially designated as HELICOP-HUTS (Model 150) as manufactured by the Craig Systems, Inc. of Lawrence, Mass. and were originally designed for transportation by helicopters, hence the trade name. They are of double-sheathed aluminum construction with thermal insulation between the sheathes and, in addition to being reasonably light, are quite strong. Being entirely of aluminum (except for the insulation) they are completely termite-proof. Permanent lifting eyes and suitable lifting harnesses are provided that facilitate their ready handling, either for loading or placement, wherever a crane or other lifting gear is available. Needless to say, they are entirely weatherproof, even the entrance door being gasketed and provided with heavy "dog" type latches.

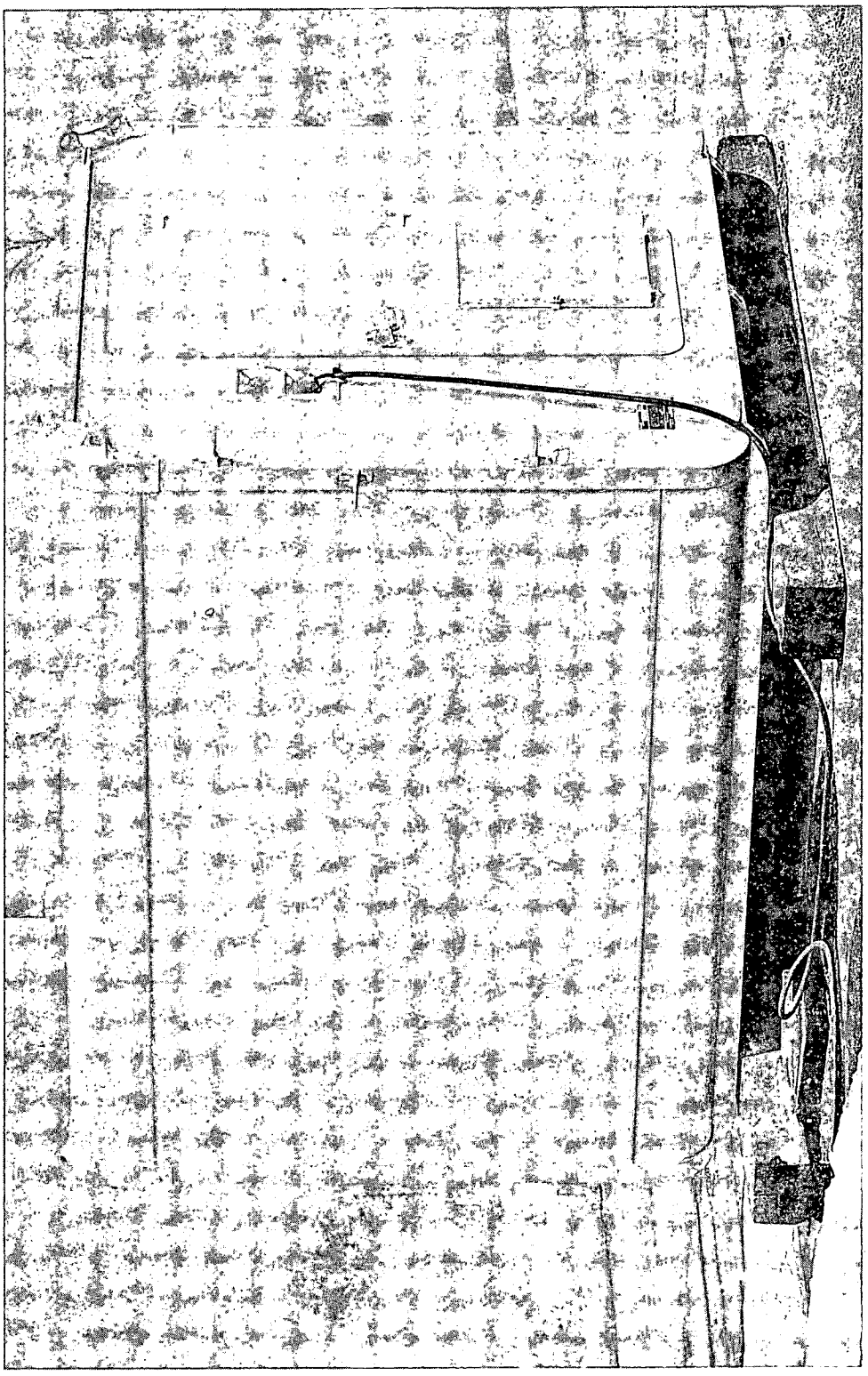

Figure 4 - Exterior of Standard Hut

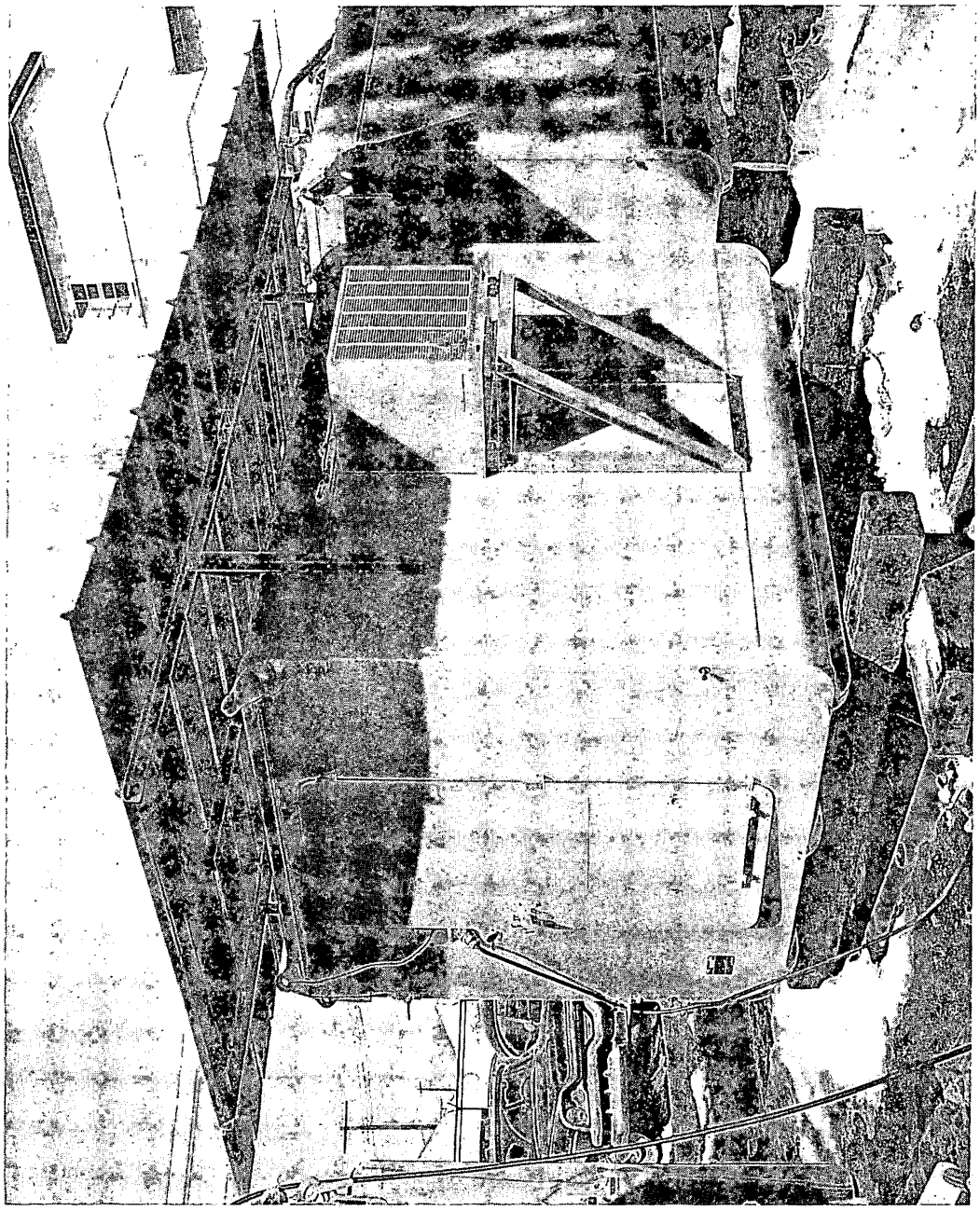

Figure 5 - Exterior of Tropicalized Hut

All the huts have rounded corners and edges both outside and in to provide additional strength and to preclude damage and are finished both externally and internally with a hard lacquer, light gray in color.

With the exception of one hut intended for tropical installation, all the huts are entirely similar and of the same size. The tropicalized hut is basically of the same size as the others, excepting that its maximum installed width is increased by twenty-four inches because of the air-conditioning unit that is externally mounted and its height by eight inches because of a sun canopy over the roof.

The outside dimensions of the huts are as follows:

Length 100" Width 80" Height 77"

Internally the huts are four inches smaller in all dimensions because of the double sheathing and thermal insulation.

Figure 4 is an oblique view of one of the standard huts showing the entrance door and the two antenna arrays mounted above the roof.

Figure 5 is a similar view of the tropicalized hut and shows the sun canopy and air conditioner in place.

6.12 Habitability Provisions

The electronic equipment with all units operating dissipates some 1,476 watts. Means are required to remove this heat from the huts, particularly in warm weather. To accomplish this, two eight-inch exhaust fans are provided in the bulkhead opposite the door. These may be seen in Figure 2. They provide a circulation of air from the door through the entire hut. For inclement weather, the lower section of the door is provided with louvers which may be opened to permit the ingress of air. An air filter is provided behind these louvers.

For cold weather operation, each hut is provided with a 3000-watt electric heater equipped with a blower and controlled by a thermostat to maintain the huts at a uniform temperature.

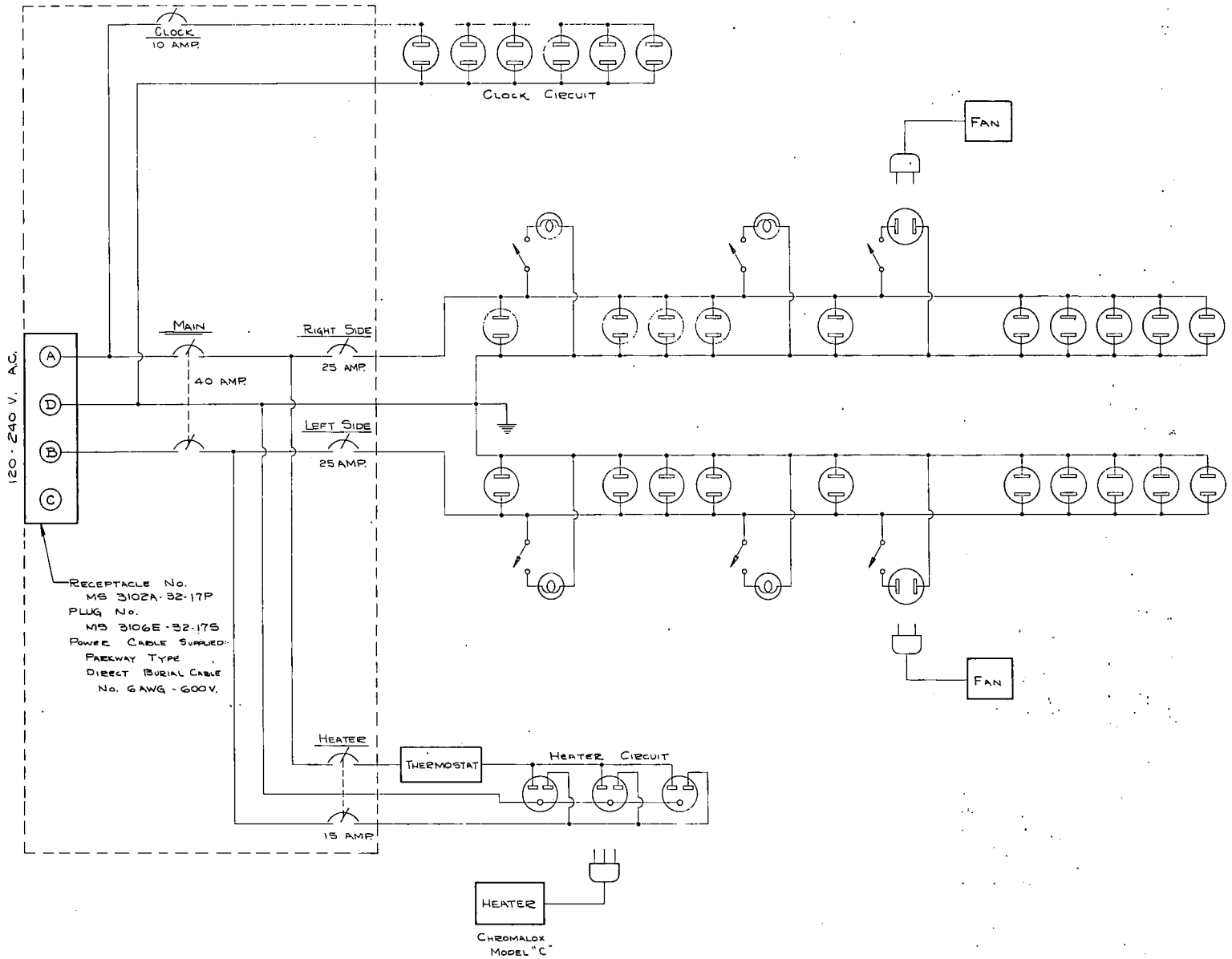

Figure 6 - Wiring Diagram of Power Circuits

And, as has been previously mentioned, all the huts are provided with 1 1/2 inch of special insulation which, in company with their double aluminum skins, provides for excellent thermal insulation against the ambient temperature.

The one hut intended for tropical installation has been especially treated for this use. First, it is provided with an aluminum canopy completely covering its roof and extending approximately 3 feet beyond its sides to serve as a sun shade. Approximately 6 inches of air space is provided between this canopy and the roof of the hut. In addition, General Electric Company Model R-681S air conditioner is mounted in one of the longer walls of the hut. This air conditioner has a capacity of approximately 13,000 BTU/hr which is ample to maintain the hut livable with all equipment operating in an ambient temperature of 130°F.

6.13 Electrical Distribution System

All the huts are wired for operation on a (rated) 120/240 volt single-phase three-wire transmission system with grounded neutral. A water-tight male receptacle is provided in a small alcove adjacent to the door on the outside of each hut into which a three-wire portable cable of suitable length (provided with each hut) may be plugged. Immediately behind this, inside the hut, is a small switch panel from which square conduits are carried around each side and the operating table end of the huts. Hence each half of the hut is on opposite sides of the three-wire system for load equalization. These conduit runs are provided with numerous outlet receptacles into which the various pieces of electronic equipment and other devices may be plugged. A separate 240-volt line is run for the heater, which operates on this higher voltage. Similarly, a separate line is run for the Time Code Generator and electric clocks which must operate continuously. This permits all power to be switched off the hut by the Main Line Switch on the power panel without deranging the Timekeeping System.

Figure 6 shows the power wiring in detail.

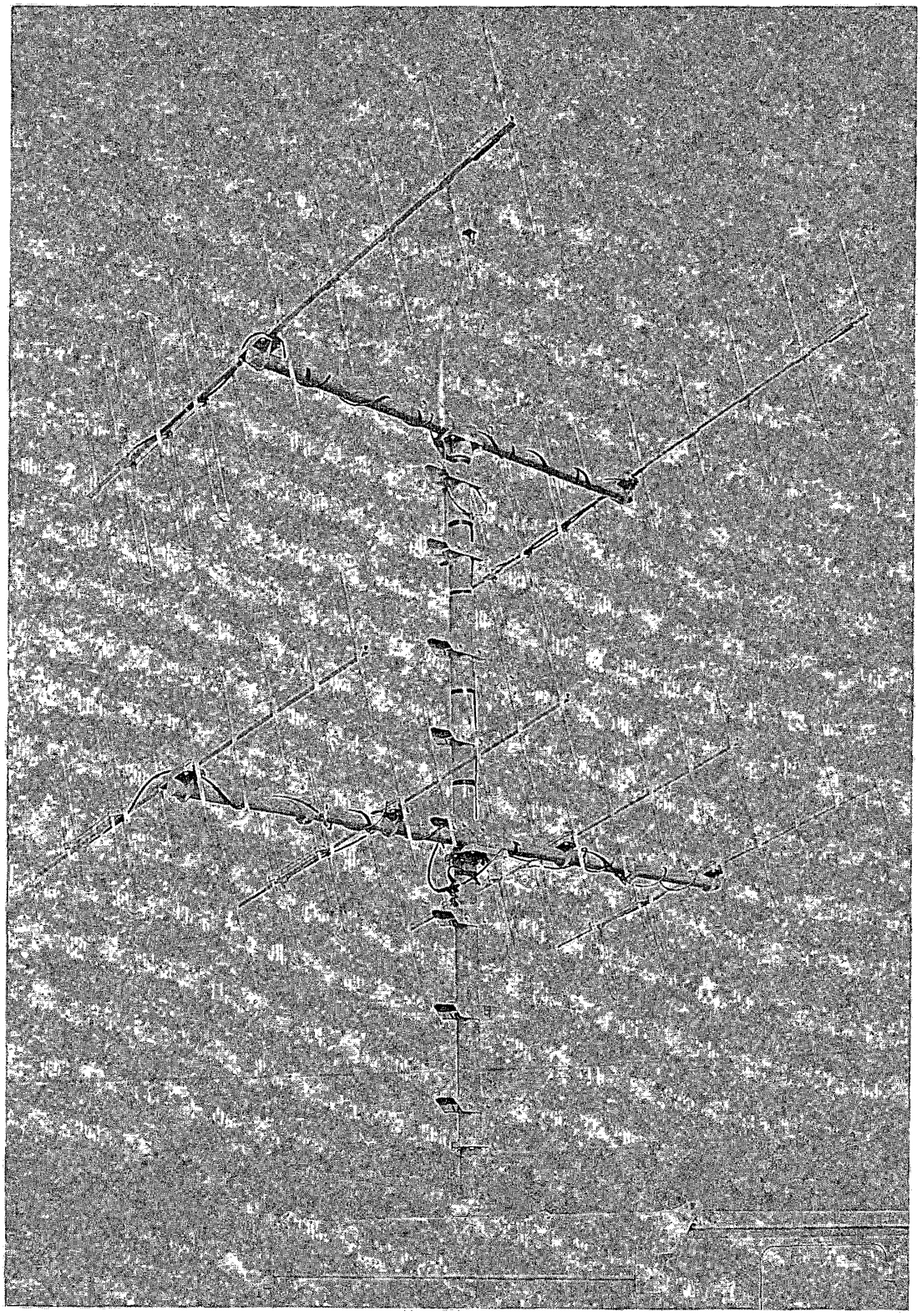

Figure 7 - The VHF Antenna Arrays - Side View

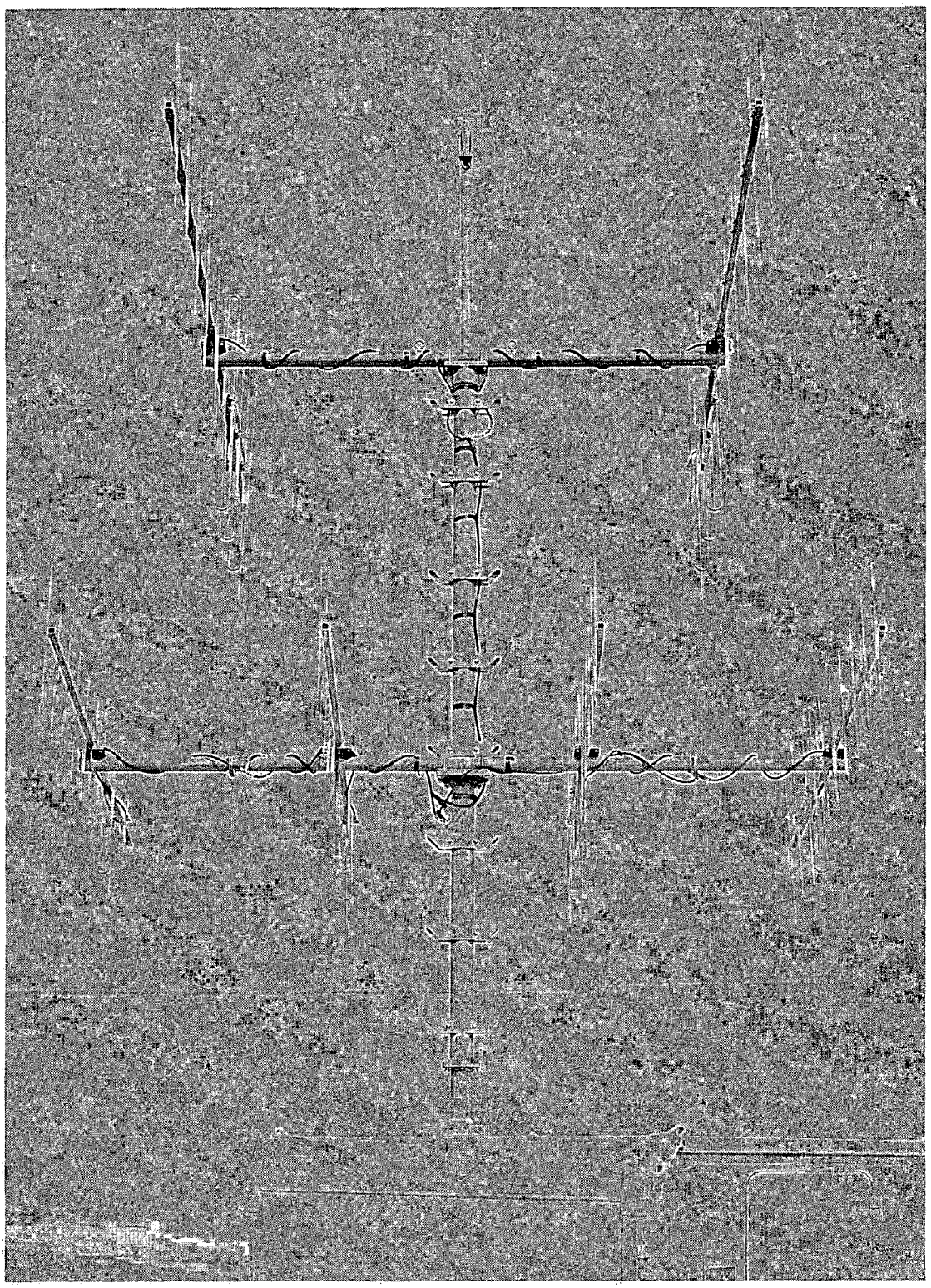

Figure 8 - The VHF Antenna Arrays - End View

6.2 THE ANTENNAS

6.21 General Description

Three different antenna systems are provided for each facility. Two of these are Yagi arrays designed for the reception of vertically polarized signals in the VHF bands. The third is a vertical monopole intended for the reception of vertically polarized signals in the HF bands.

The VHF Yagi arrays are mounted on a four-inch aluminum shaft extending approximately twelve feet above the overhead of the huts near the end opposite the door. The lower end of this shaft runs in a cast aluminum pedestal secured to the deck of the huts. Because of the inertia of the antennas, the shaft is not rotated directly by the handwheel but is driven through a set of planetary gears introducing a reduction ratio of 6:1. To avoid the use of rotating joints, the transmission lines from the antennas are allowed to twist inside the hollow shaft as it is rotated. To permit of this, stops are provided that limit the angle of rotation to approximately 520 degrees.

The upper array is a two-bay ten-element Yagi.

The lower array is a four-bay ten-element Yagi.

Both antenna arrays are mounted at a 15-degree angle above the horizontal and are pointed in the same direction. Figures 7 and 8 are close-up views of these arrays as mounted.

The twenty-five-foot vertical antenna is designed for mounting in the field approximately forty feet from the hut, being equipped with special mounting legs that will support it in heavy winds without guying or staking. Because of the unknown nature of the ground on which it might be located, it is provided with a seventy-foot counterpoise system of sixteen radial copper wires. The antenna is of the tubular whip type with three tapering sections and, while extremely strong, is quite light and easily erected.

6.22 Detailed Description

6.221 The VHF Antennas:

Both the VHF antennas mounted atop the hut on a rotatable shaft, one above the other, are Yagi arrays and are of commercial design and construction, being manufactured by the Technical Appliance Corp. of Sherburne, New York. The top array (see Figures 7 and 8) consists of two bays while the lower array has four bays. They will be so designated herein. Their characteristics are as follows:

Characteristics	2-Bay Array	4-Bay Array
Polarization	Vertical	Vertical
Horizontal Beam Width (3 db points) degrees (nominal)	30	22
Vertical Beam Width (3 db points) degrees (nominal)	50	50
Gain vs Isotropic Antenna, db	14	16
Impedance, ohms	50	50
Total Elements per Antenna	10	10
Driven Elements	3	2
Reflectors	1	1
Directors	6	7
Spacing between antennas in an array, feet	8.3	4

Both of the antennas are of aluminum construction and are coated with a weather resistant lacquer to further reduce corrosion. The ends of all the tubular members are pinch sealed to preclude the entrance of moisture.

Both the arrays are pointed accurately in the same direction (with respect to the shaft) and are tilted upward at an angle of 15 degrees.

Figures 7 and 8 are close-up views of the assembly and arrays as mounted. This, together with a description of the erection techniques given in the INSTALLATION section, will give a clear idea of their mountings.

The feed lines for the two arrays are carried partly within the mast and consist of two type RG-8A/U cables approximately fifteen feet in length. The mast cable for the four-bay array connects directly to the bridle, whereas the feed line for the two-bay array has an additional length of eight feet of RG-9B/U between the mast cable and the bridle. Type N cable fittings are used throughout. The fifteen-foot length of cables within the mast allows sufficient slack to permit them to twist without damage as the shaft and its arrays are rotated. However, to protect them from damage from excessive twisting, the rotating mechanism has stops associated with it that limit the rotation to approximately 520 degrees.

The antenna arrays as mounted weigh in the neighborhood of one-hundred-fifty pounds and have an appreciable moment of inertia. Because of this, it was found impossible, or at least undesirable, to attempt to rotate and hold them, particularly in any wind, by direct handwheel control. Accordingly, within the huts the rotating handwheel is connected to the antenna shaft through a planetary gearing system with a ratio of 6:1. In addition, a drum-type brake is provided to secure them in any position when not in use.

The operating handwheel (shown in Figure 2 together with the azimuth scale calibrated in degrees) is twenty inches in diameter and with the gear ratio provided permits easy operation with little effort.

The end stops that limit the rotation to 520 degrees are provided with heavy resilient bumpers to preclude damage to any part of the antenna structure when struck.

6.222 The HF Antenna:

To permit the reception of time signals or possibly other communications, each facility is provided with a flagelliform or whip antenna, i.e. a vertical monopole, suitable for reception in the 5 - 25 megacycle range. This is a three-section stainless steel tubular member self-supported on an insulator which in turn is supported on a steel footing in the form of a cross.

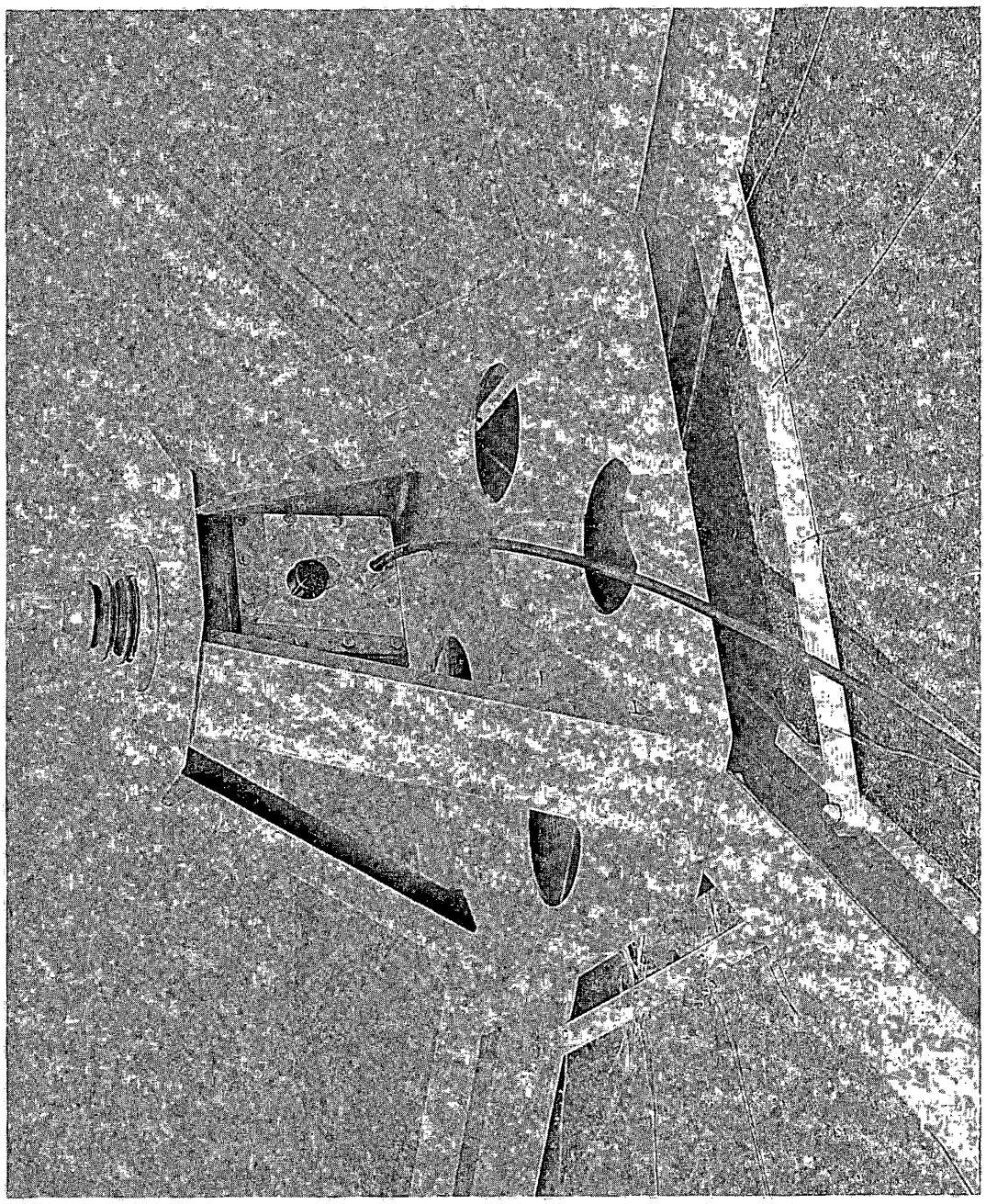

Figure 9 - Base Arrangement of Vertical Antenna

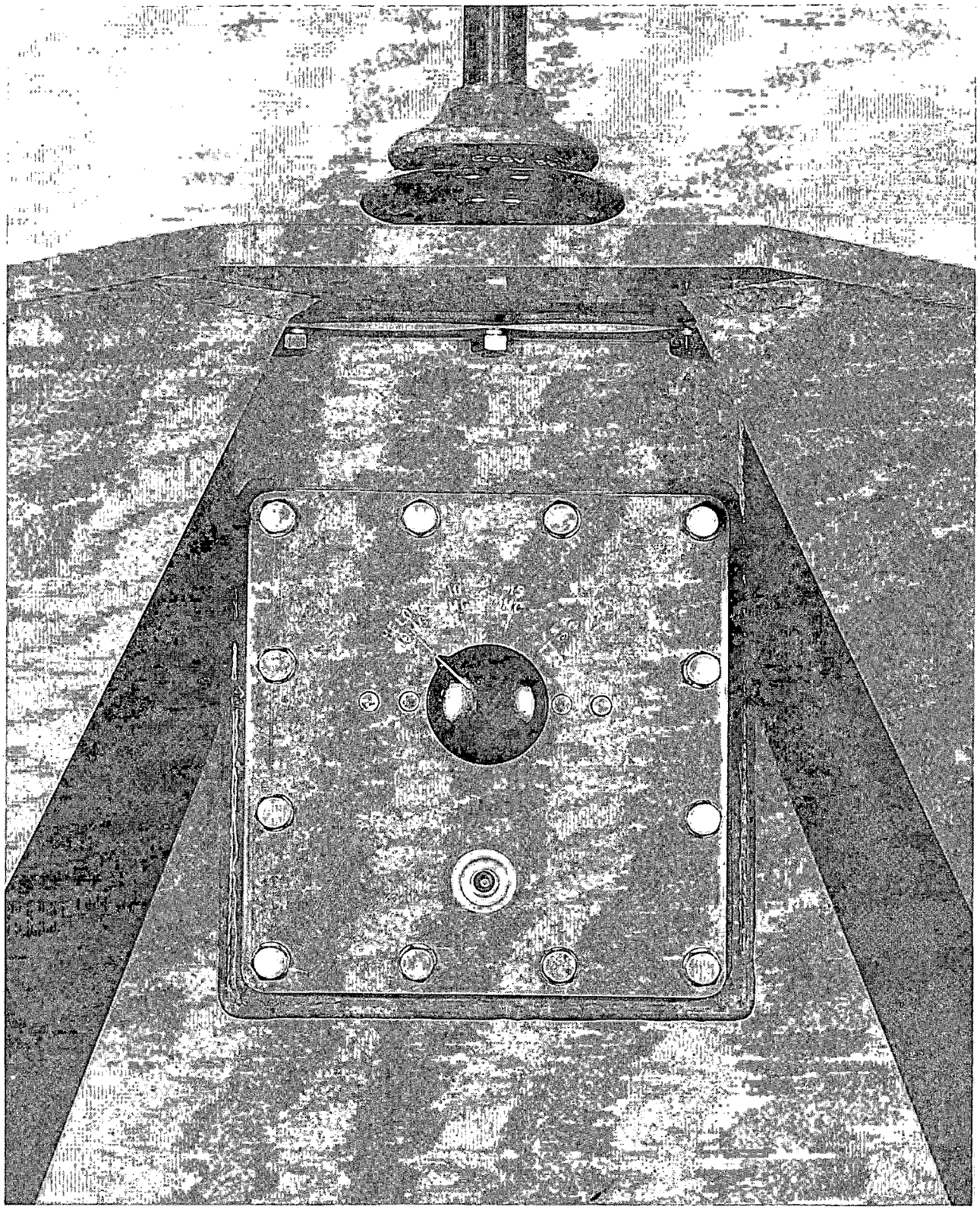

Figure 10 - Exterior of Vertical Antenna Matching Unit

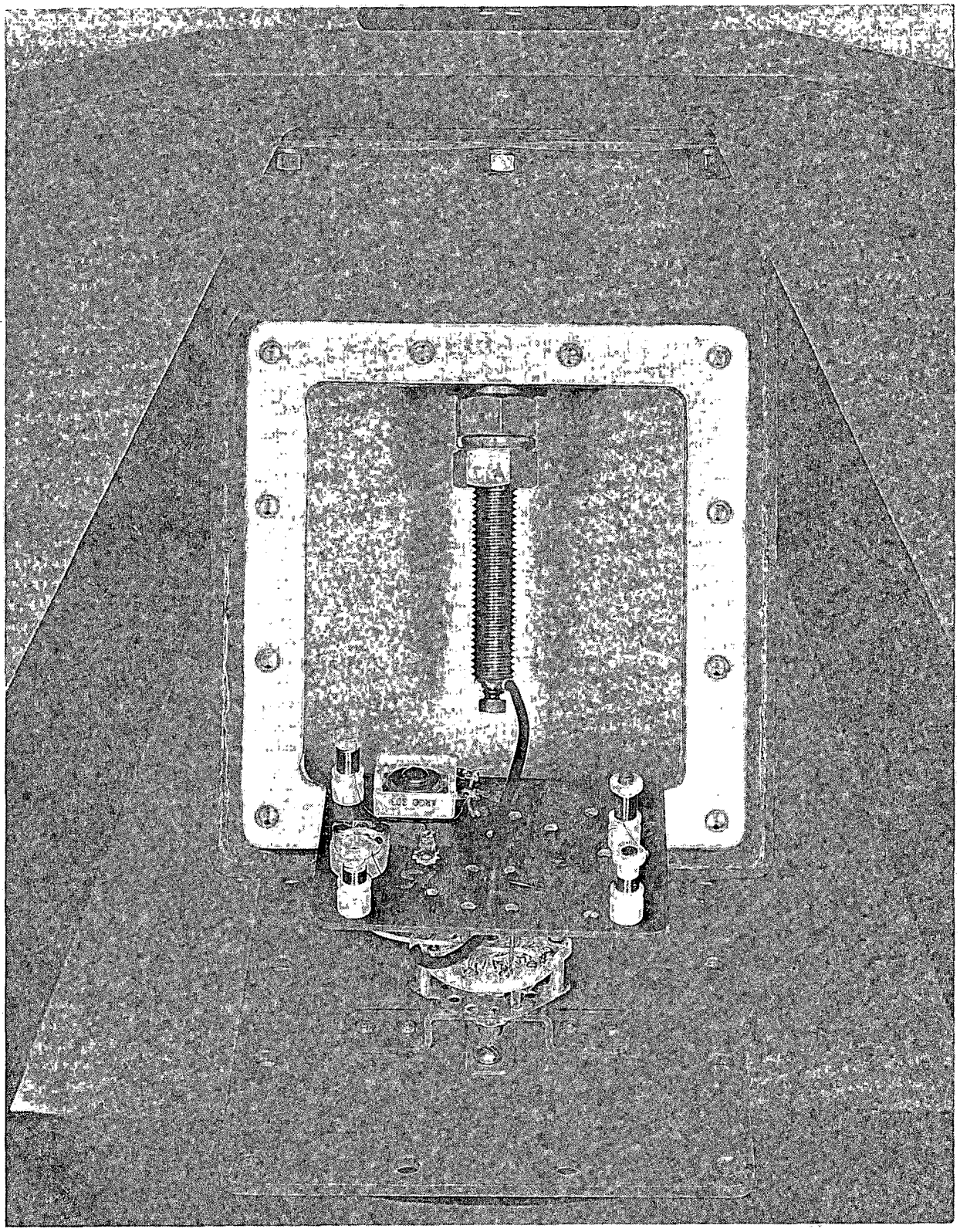

Figure 11 - Interior View of Vertical Antenna Matching Unit

To increase the effectiveness of this antenna, it is provided with a counterpoise system consisting of sixteen radially arranged copper conductors approximately thirty-five feet long. In addition, a matching network is provided, mounted in a water-tight box at the base of the antenna, to permit it to be matched to a 50-ohm transmission line at 10, 15, and 20 megacycles. The antenna height is approximately thirty feet above ground level, and is designed to withstand a one-hundred-mile-per-hour wind load. It is intended for installation adjacent to the hut but forty or so feet removed. A fifty-foot transmission line is provided for connection to the hut, which is accomplished through a Type N connector mounted in the wall of the hut just above the power receptacle.

Figure 1 is a view of the vertical antenna and counterpoise as installed adjacent to the hut.

Figure 9 shows the mounting legs and counterpoise connections.

Figures 10 and 11 are close-up views of the impedance matching unit installed at the base of the antenna.

6.3 THE RECEIVING SYSTEMS

6.31 General

Two separate, complete and distinct receiving systems are provided. These have been arbitrarily designated as Channel A and Channel B. Each system is identical in all respects, except for the frequencies on which they are intended to operate and for certain control and switching arrangements which will be described later. Accordingly, a description of one channel should be sufficient for both.

Fundamentally, the systems are of the multi-conversion, superheterodyne type obtained by employing a VHF converter ahead of a standard type R-390A/URR receiver. This arrangement and the type of units chosen is such as to produce a system with a high degree of frequency stability and accuracy, high gain and a low noise figure, making for very high sensitivity.

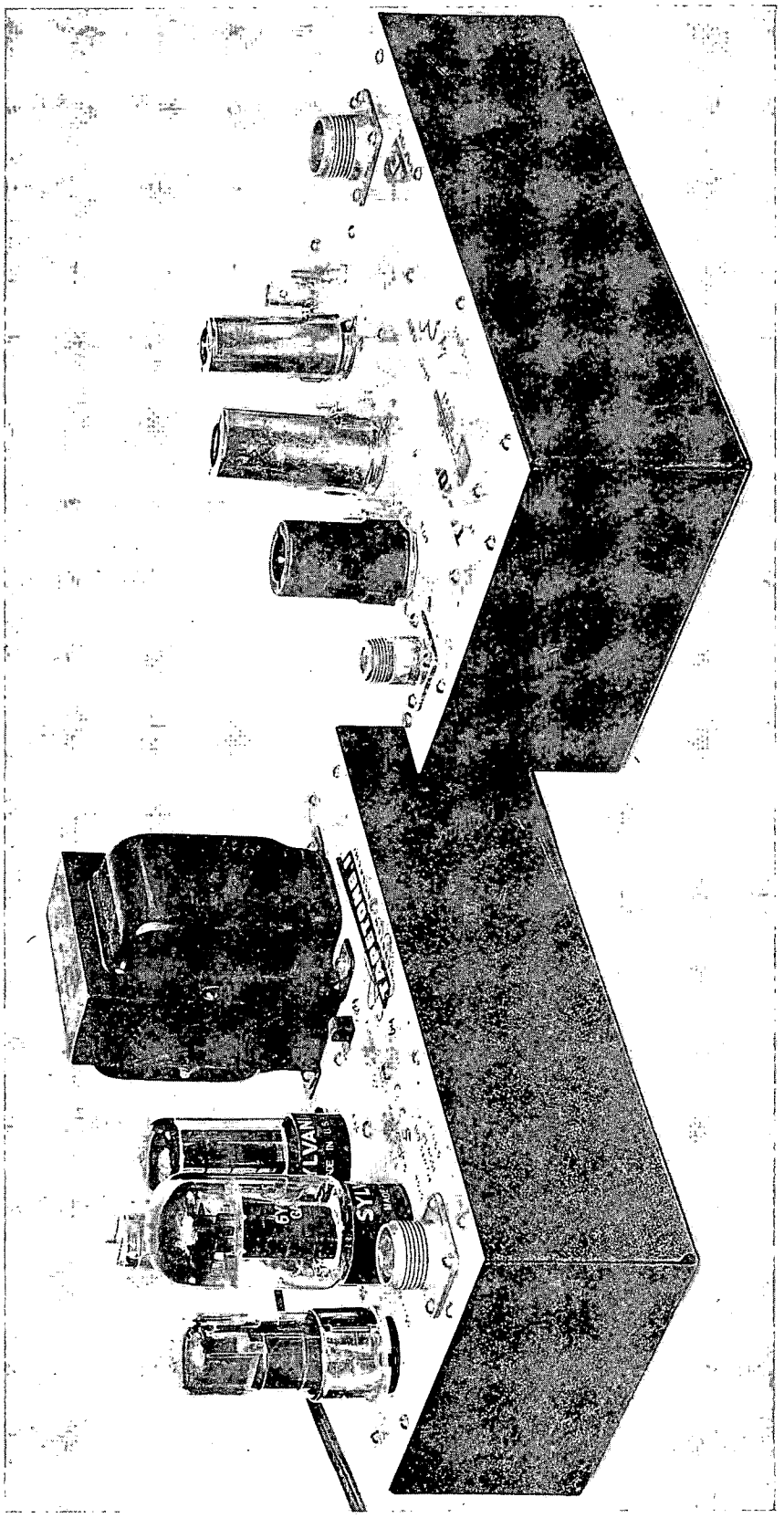

Figure 12 - Converter and Power Unit

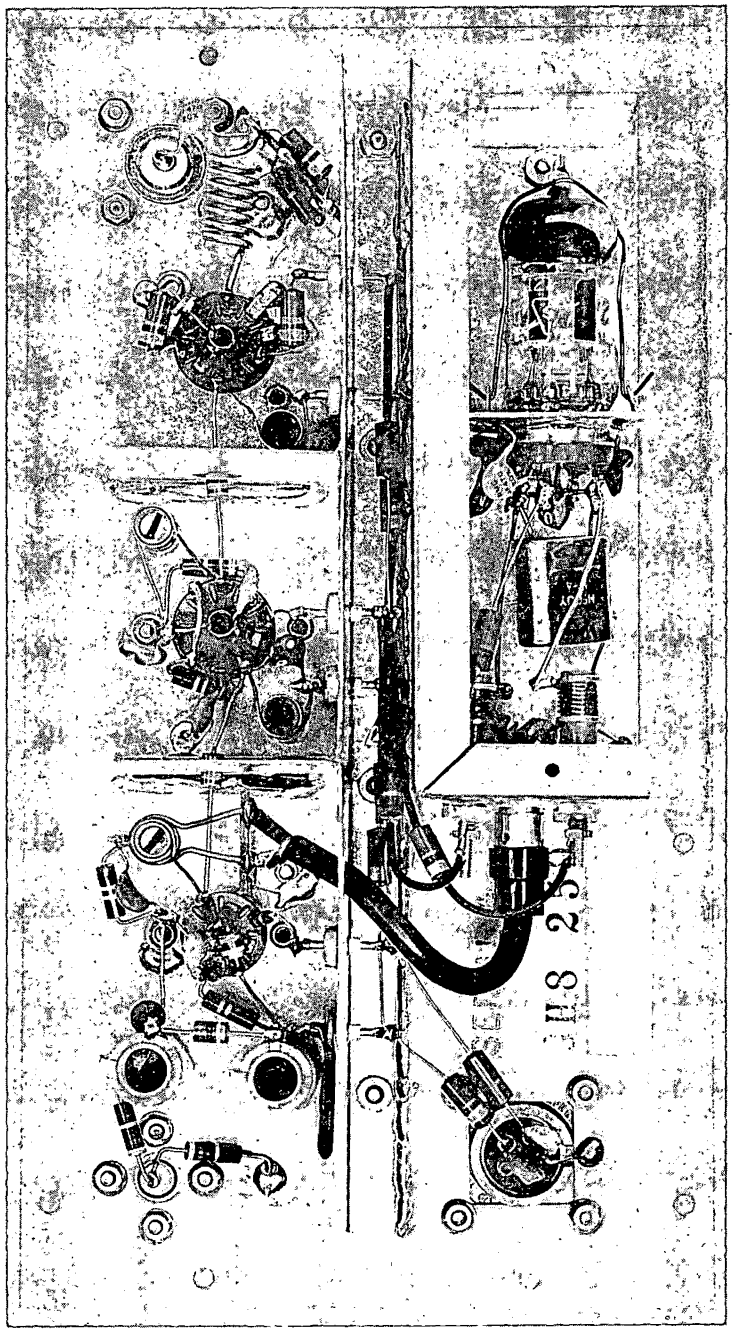

Figure 13 - Interior of Converter Showing
Oscillator Compartment

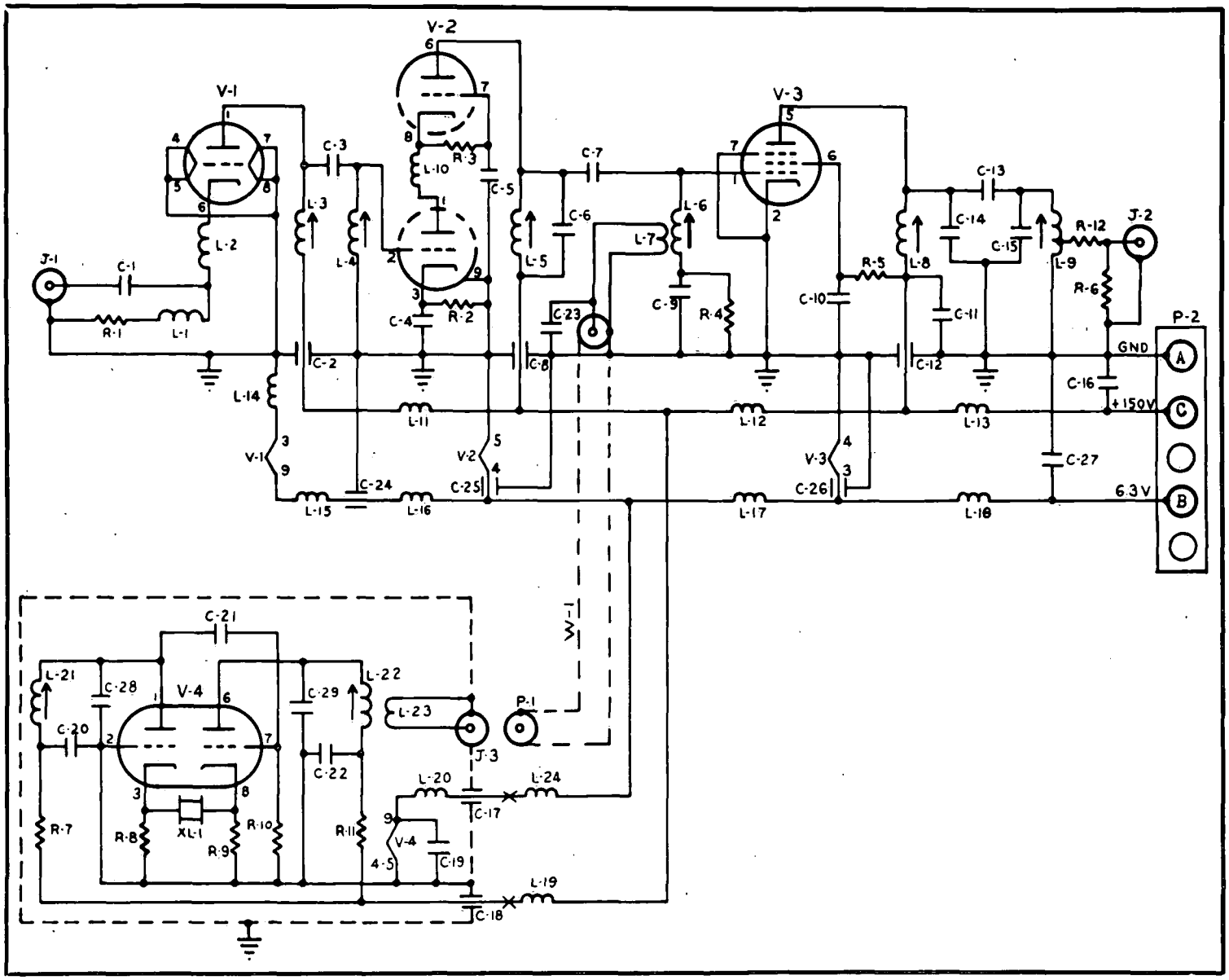

Figure 14 - Schematic Diagram of Converters

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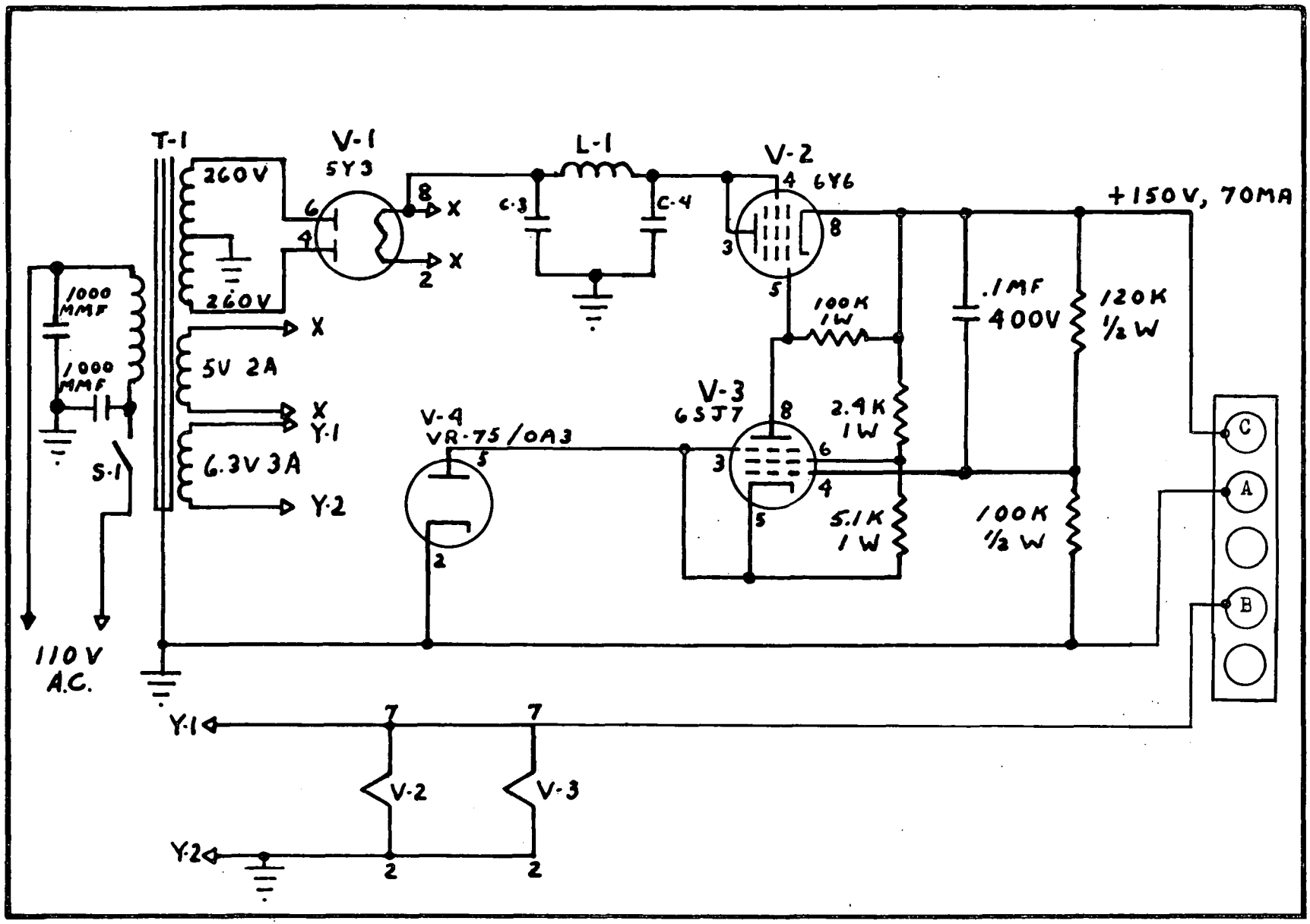

Figure 15 - Schematic Diagram of
Converter Power Units

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6.32 The Converters

The Converters and their power units were designed and manufactured by Tapetone, Inc. of Webster, Massachusetts. They consist of a Type 417A input tube operated with grounded grid, which possesses a quite low noise level, followed by two stages of r-f amplification and a combined mixer/output tube. The conversion oscillator is crystal controlled, employing standard MIL crystals. The higher frequency converters employ Type CR-56/U crystals in Type HC-18/U holders while the lower frequency units employ Type CR 55/U crystals in Type HC-18/U holders. The crystal frequency is doubled out of the oscillator tube and the doubled frequency is on the low side of the incoming frequency. The Converter power units are electronically regulated and supply 150 volts to the Converters, as well as the heater power, which is not regulated.

Both the Converters and power units are mounted in sheet metal boxes of the same size, namely 9 1/2 inches long x 5.0 inches wide x 2 1/2 inches high, with the tubes mounted on top, except for the conversion oscillator which is contained in a separately shielded compartment within the main box.

The Converters have a Noise Figure of 2-3 for the lower frequency units and 4-5 for the higher frequency units, with power gains in excess of 20 db.

Figure 12 is an exterior view of one Converter with its power unit, while Figure 13 is an interior view of a converter. Figures 14 and 15 are schematic wiring diagrams of the low and high frequency converters and the power units respectively. The only difference between the converters is in the valves of the various inductors.

The input and output impedance of the Converters is approximately 50 ohms.

Because of the importance of the Converters to the receiving system, two Converters are supplied for each Receiver together with a power unit for each. These are mounted in drawers, two of each to a drawer, which slide into a framework below the operating table on the extreme left. In Figures 2 and 3 the two upper units are the Converter drawers (the lower one housing the Power Unit for the Time Code Generator.

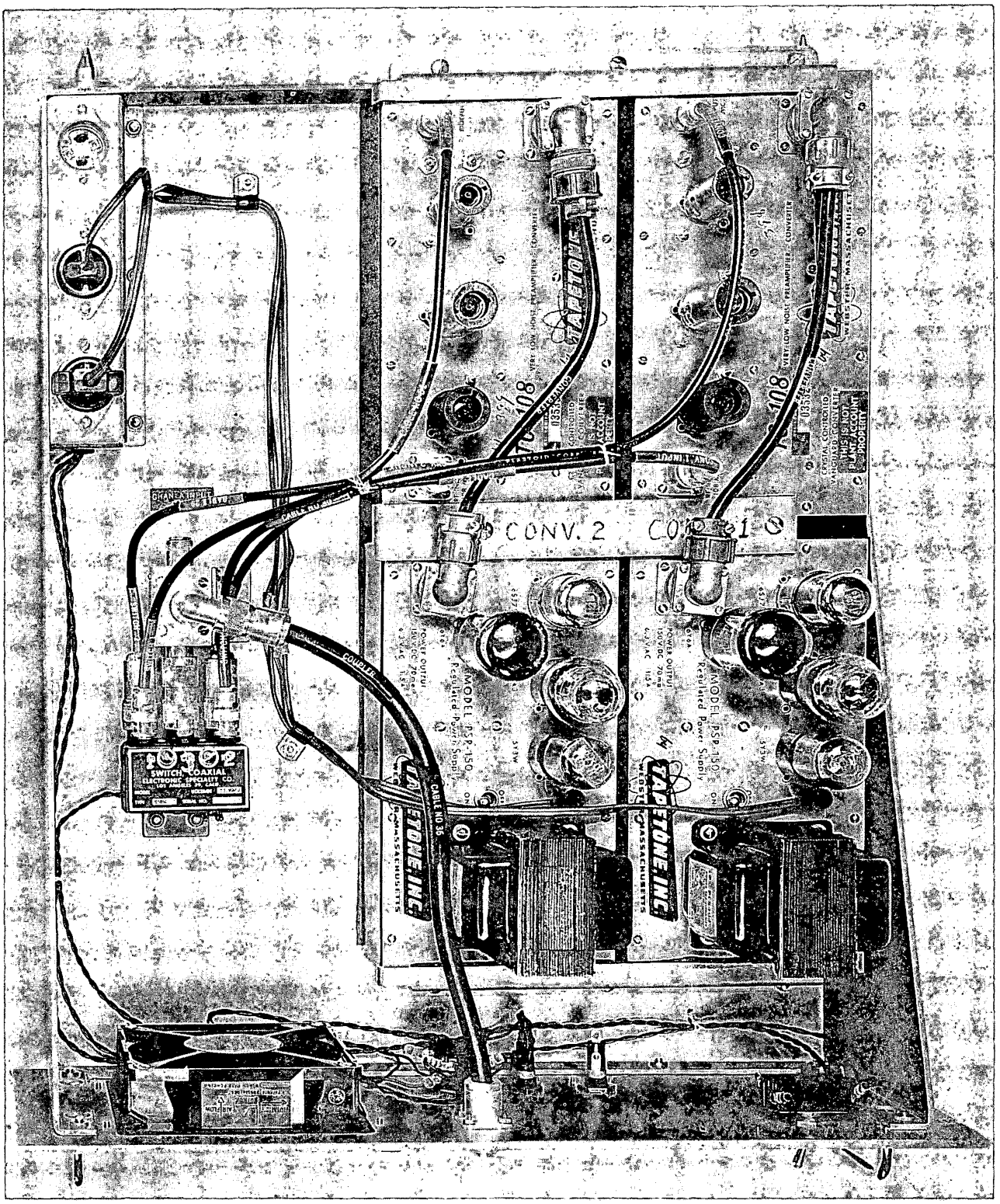


Figure 16 - Channel A Converter Assembly - Interior View

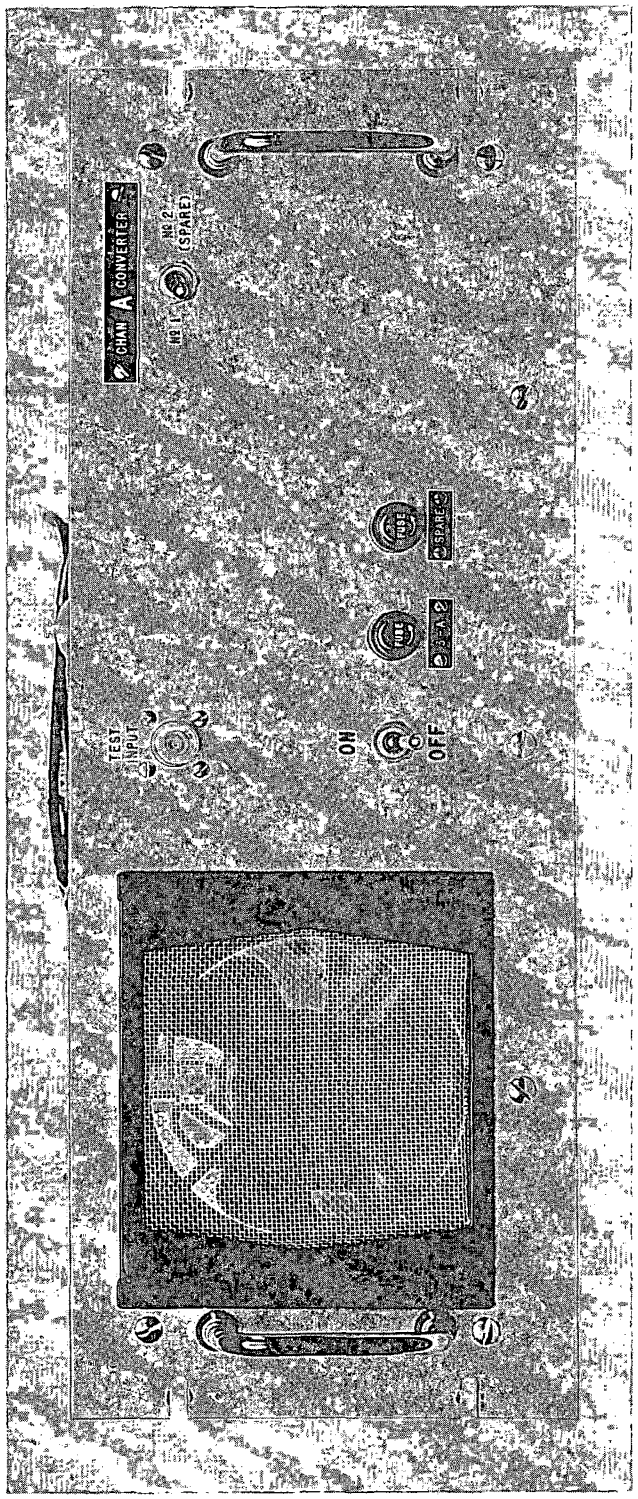


Figure 17 - Channel A Converter Assembly - Panel View

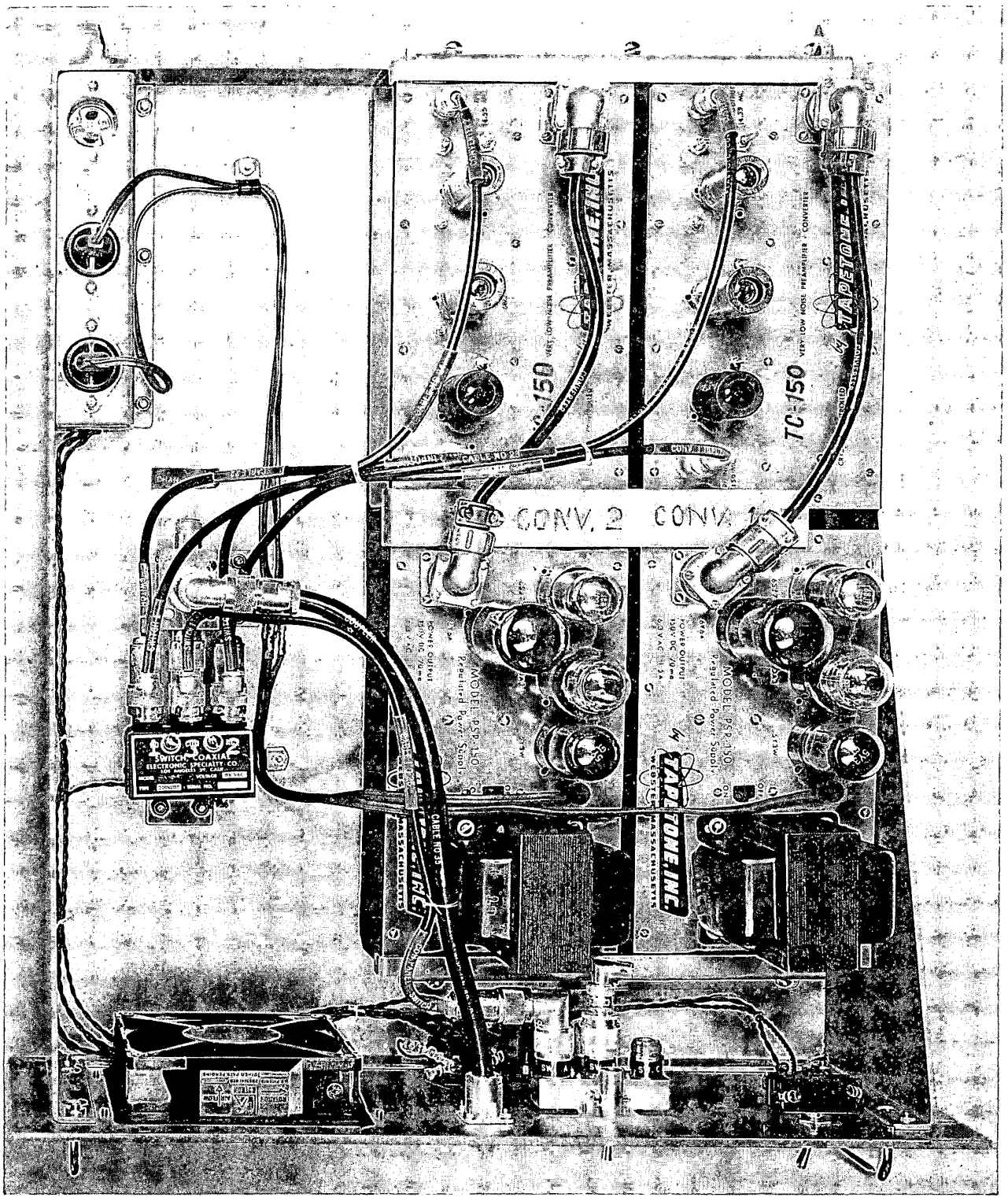


Figure 18 - Channel B Converter Assembly - Interior View

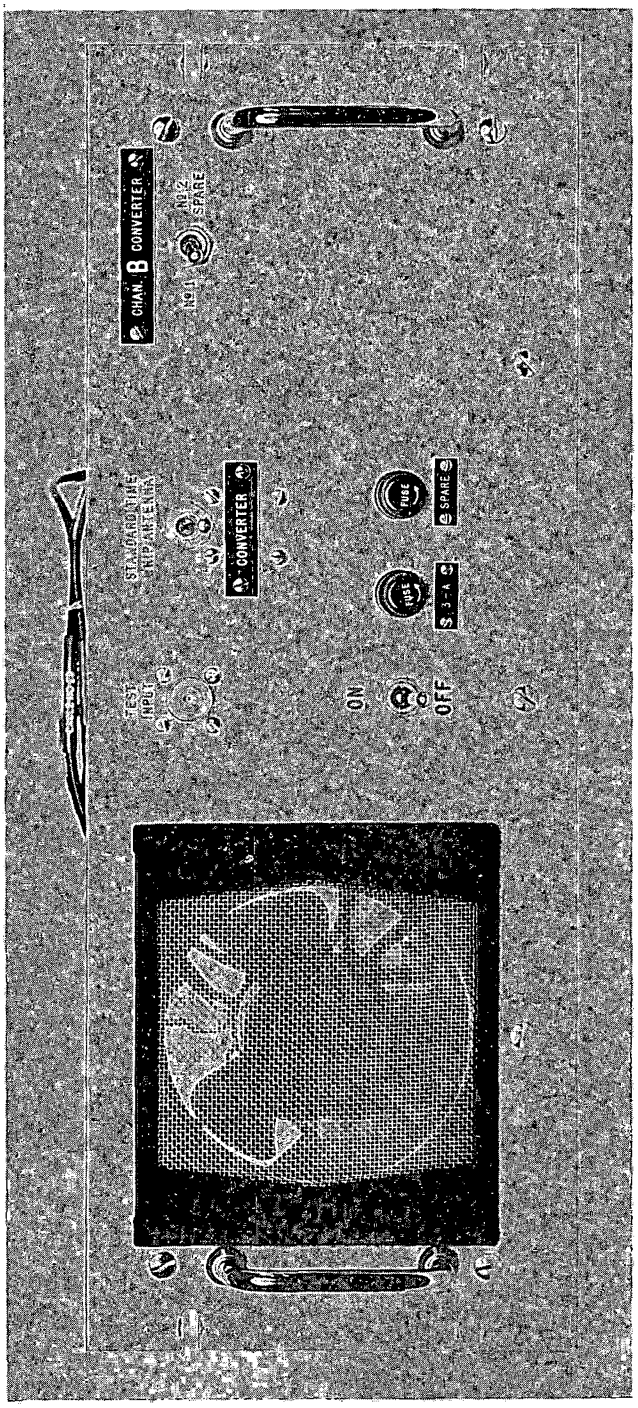


Figure 19 - Channel B Converter Assembly - Panel View

Figure 16 is a close-up of the Channel A Converter drawer. The two Converters and their Power Units are clearly visible. The object to the left with many coaxial cables connected thereto is a magnetically operated D. P. D. T. coaxial switch that transfers the antenna and receiver from one Converter to the other when thrown by a toggle switch mounted on the panel of the assembly and marked "#1" and "#2 (Spare)". The bright rectangular object directly behind the coaxial switch and connected thereto is a 70-db directional coupler connected to a coax receptacle on the panel to which a signal generator may be connected for injecting a test signal into the Converter inputs. The two power units plug into receptacles near the back of the drawers which are energized through an ON-OFF toggle switch on the panel. When this is thrown "ON", both Converters are energized, although if it is desired that one of them be kept inactive, it may be readily unplugged from the power receptacle. It might be mentioned that the magnetic coax switch is energized in the "#2 (Spare)" position so that, as normally used, this switch is de-energized, thus relieving the windings. Figure 17 is a panel view of a Channel A Converter and shows the various switches.

The rectangular object mounted on and behind the left hand side of the panel is a small exhaust fan (that is turned ON and OFF with the Converters) to dissipate the heat generated by these units.

Figures 18 and 19 are close-ups of the interior and panel of the Channel B Converters. These are the same as the Channel A units except for the addition of one item: the bright rectangular box with three coax cables connected thereto, mounted near the top center of the panel. This contains a manually operated S. P. D. T. coax switch which permits the input of the Channel B receiver (i. e., the R-390A/URR) to be thrown from the Converter output(s) to the vertical whip antenna. This allows this receiver to be used for the reception of TIME SIGNALS (or other communications) as well as for its normal use as the IF section of the VHF channel.

6. 33 The Radio Receivers

These equipments are standard R-390A/URR receivers and in no way have been modified for use in the systems described herein. Their design, operation and maintenance are completely covered by their comprehensive Technical Manual "TM 11-856A", copies of which will be made

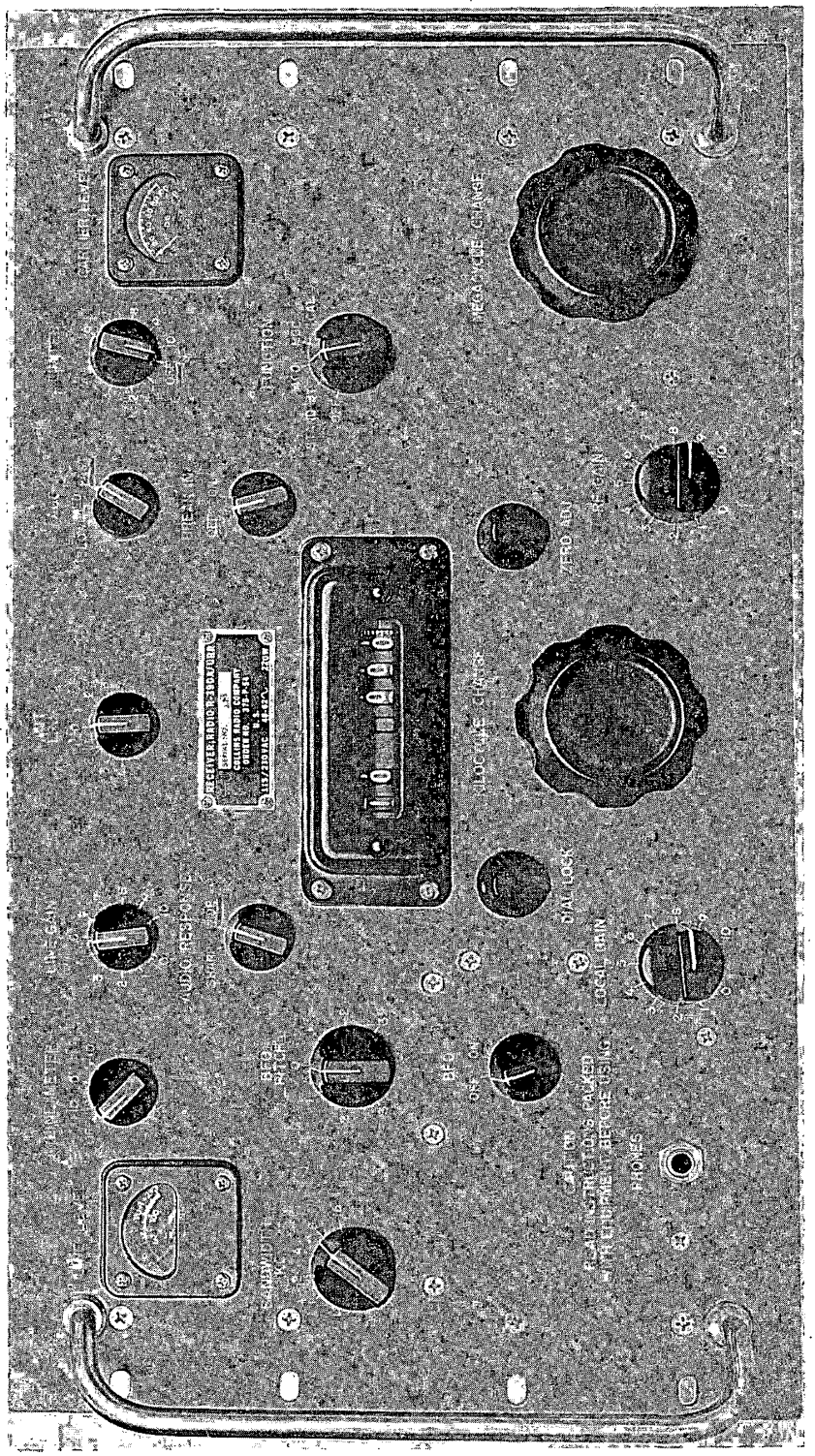


Figure 20 - R-390A/URR Receiver in Rack

available to the operating and maintenance personnel involved. Accordingly, only a brief description of these receivers will be given herein in the interest of clarification for those who might not be familiar with them and have no copies of TM 11-856A available.

They cover a frequency range of 0.5 - 32 megacycles in 32 one-megacycle bands and are suitable for all the common forms of reception, i.e., cw, mcw, etc. They posses quite high gain and moderately high sensitivity, their Noise Figure averaging approximately 7. Their most unique and desirable features are their wide band spread, their frequency stability, frequency accuracy and their ease of tuning and frequency indication.

Figure 20 is a close-up of the panel of one of these receivers. It will be noted that the Frequency Dial is of the counter type and quite large, so that frequencies are shown numerically down to one kilocycle. A vernier dial carried on the right of the 1-kc drum (hardly visible in the Figure) is calibrated in 200-cycle increments and may be interpolated to approximately 50 cycles.

This extreme accuracy of frequency indication is made possible and useful by virtue of a self-contained 100-kc crystal calibrator and means for setting the counter dial accurately against the crystal harmonics.

The various panel controls are more or less conventional and may be seen with their designations in the Figure.

Fundamentally, the R-390A/URR receivers are of the multi-conversion type, employing triple conversion up to 8 Mc and double conversion from 8 to 32 Mc.

Their high order of frequency accuracy and frequency stability is obtained by their unique method of amplification and conversion. Unlike many conventional receivers, all the r-f as well as the i-f stages are band spread and switched as the thirty-two bands are switched, rather than the r-f stages being continuously tuned. In addition to this, all the conversion oscillators are crystal controlled and operate at fixed frequencies, except for the final conversion oscillator which is the one controlled by the tuning

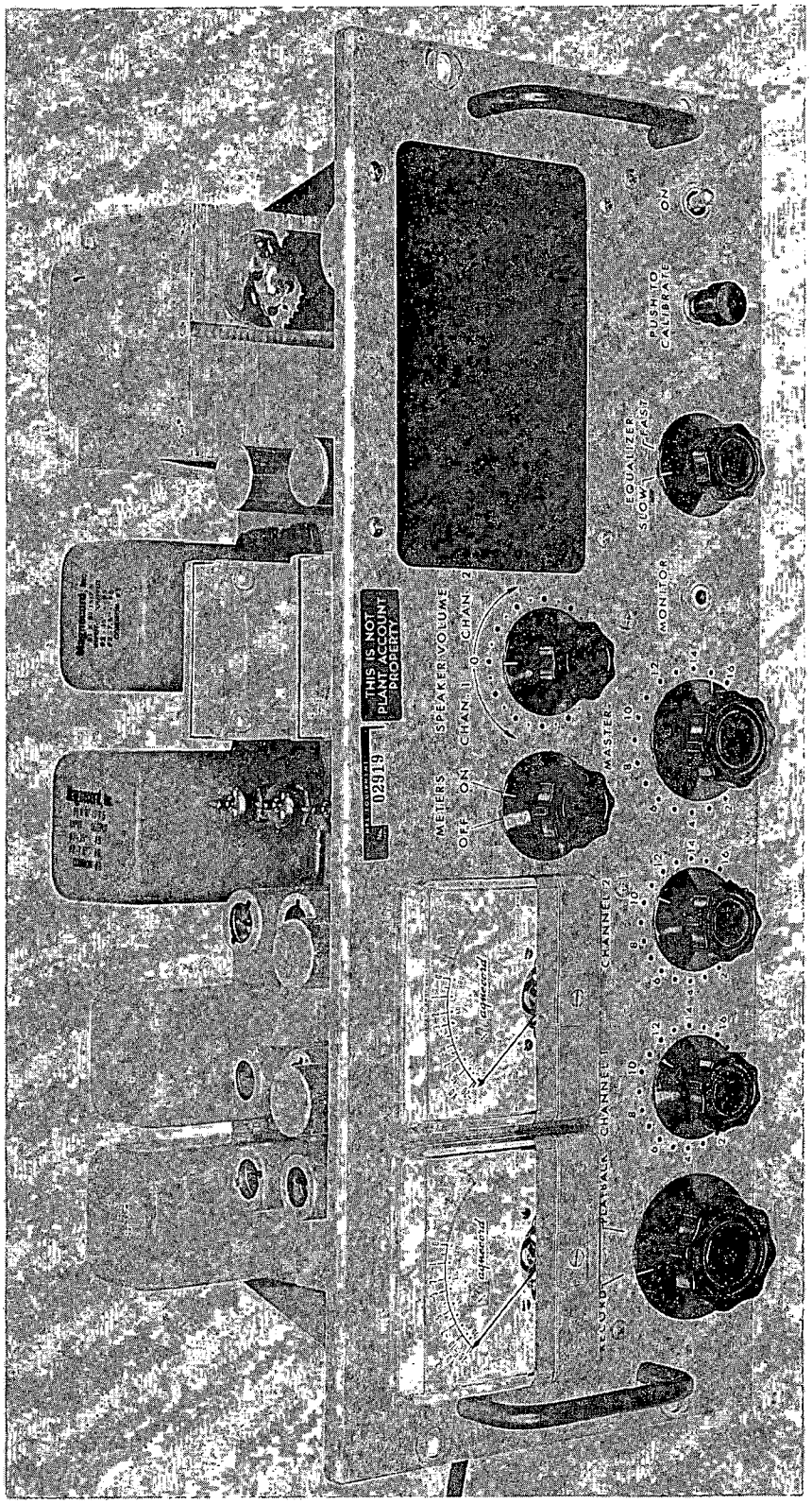


Figure 21 - Recorder Amplifier

dial and operates between 2.455 and 3.455 kilocycles for all radio frequencies. Thus the receiver has crystal accuracy and stability throughout its entire range except for the final oscillator which, operating at a relatively low frequency through only a 1-kc band, can be made and is quite stable.

6.4 THE RECORDER AMPLIFIERS

The Recorder Amplifiers are separate and distinct from the Recorders proper and are contained in individual chassis that mount in the Channel B mounting racks between the R-390A/URR receivers and the Recorders. Each Amplifier unit is complete, containing all the necessary equipment for operating and monitoring two recorder channels, both for recording and play-back, including the necessary rectifier-power equipment.

6.41 Size, Weight and Power Requirements

All the components are contained in an open chassis 7 inches high x 19 inches wide x 9 1/2 inches deep. The panel is intended for rack mounting. The total weight of the amplifier is twenty-six pounds. The unit operates on 120 volts, 50/60 cycle single phase ac and consumes approximately 218 watts while recording.

6.42 General Description

Figure 21 is a top oblique view of the Amplifier and shows the general arrangement of its components as well as the control and monitoring appurtenances mounted on its operating panel. The two monitoring VU meters are to the left of the upper part of the panel while the loud speaker is on the right. Between them, to the left,is a VU meter ON-OFF switch while beside it, on the right, is the zero-center gain control for the loud speaker. On the lower section of the panel, starting at the left, is the Record/Play-back switch. The next two controls are individual gain controls for the two channels, while next in line is a Master Gain control which increases or decreases the gain of both channel simultaneously. The next control is the Equalizer switch that changes the equalization for two different tape speeds, namely 7.5 or 15 inches per second. A jack for headphone monitoring and the power ON-OFF switch

are evident. Between them is a momentary contact push button switch marked "Calibrate". This is useful in checking the condition and match of the two amplifiers. When depressed, it puts a low 60-cycle voltage on the inputs of both amplifiers and is intended to permit the adjustment of both amplifiers for equal gain.

6.43 Circuital Description of Amplifying Equipment

The unit contains two separate and distinct but identical amplifiers. Each consists of five stages; the final or power stage, driven from a phase inverter, being push-pull. Switching is provided to permit the inputs and outputs of the amplifiers to be interchanged, so that they may be both used for either recording or play-back. Each amplifier is associated with its own head, or in effect controls its own channel on the tape. Equalization is provided in each amplifier to provide an overall system response that is substantially "flat" between 50 and 8,000 cycles for a tape speed of 7.5 ips, or 50 and 15,000 cycles for a tape speed of 15 ips. The change in equalization required for the two different tape speeds is accomplished by a panel control. Each amplifier has its own Gain control but a Master control is provided that permits varying the gain of both channel simultaneously. Individual VU meters are provided that indicate either the recording or play-back levels, being switched automatically when the tape function is switched. The loud speaker level is controlled by a single, zero-center volume control, operating clockwise for one amplifier and counterclockwise for the other.

6.44 Circuital Description of Power Equipment

The power equipment, which is contained in the amplifier chassis, consists of two separate rectifiers; one a well filtered unregulated high-voltage rectifier employing a Type 5U4G rectifier tube. Resistive/capacitive filter networks are used throughout. The dc operating voltage is approximately 270. In order to reduce heater and emission hum, a second full-wave low-voltage rectifier with resistive/capacitive networks for filtering is included. This employs a silicon crystal rectifier and is used for supplying heater voltage to all amplifying tubes excepting the four push-pull finals, which are heated on raw ac in the conventional manner.

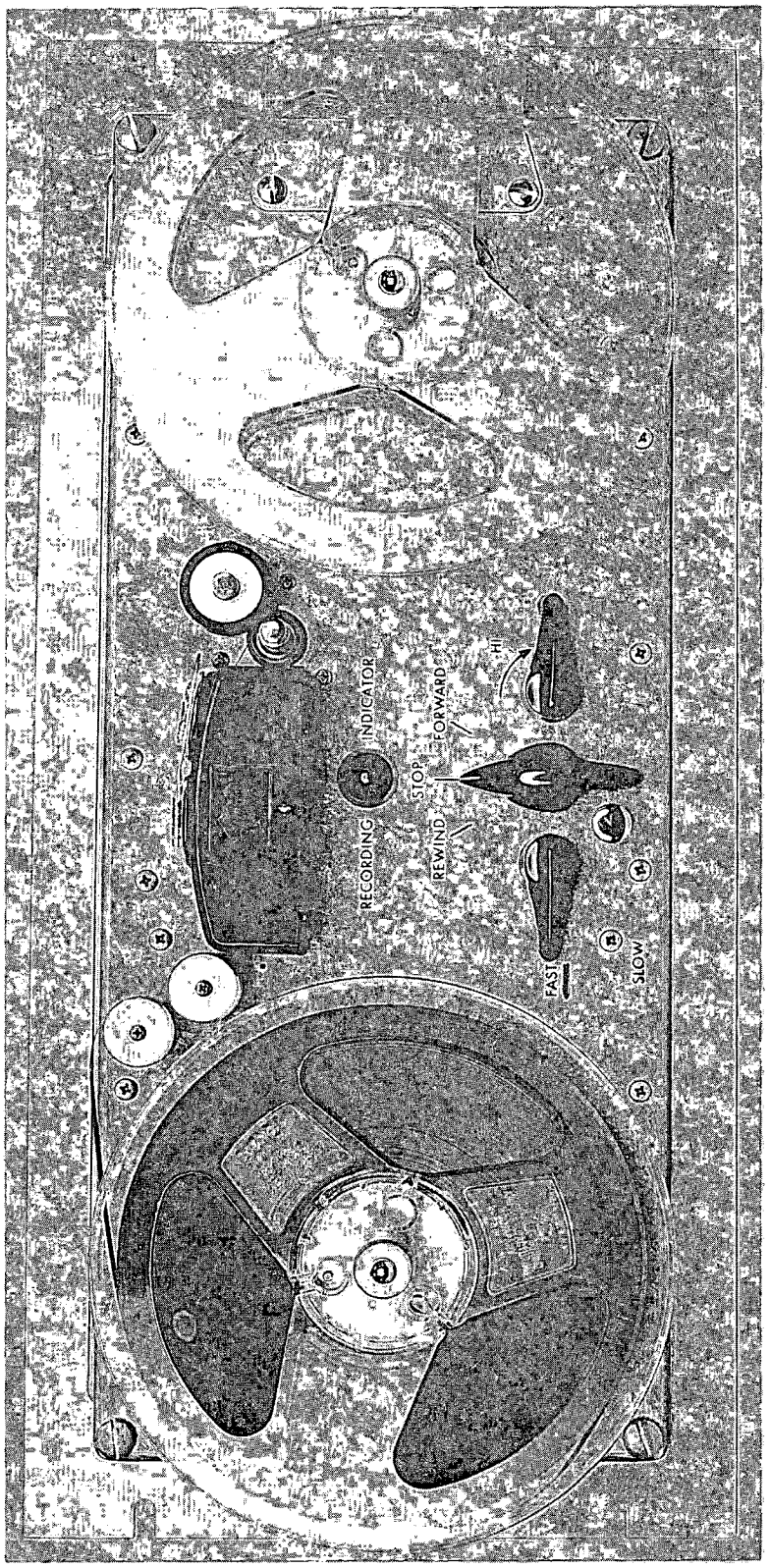


Figure 22 - The Recorder - Panel View

6.5 THE RECORDERS

The Recorders are of the dual-channel, two-speed type. They were designed and manufactured by Magnecord Inc. of Chicago, Illinois and designated as their type PT6BA2HZ.

6.51 General Description

The Recorders are contained in a chassis 8 3/4 inches high x 19 inches wide x 9 inches deep, with the panel designed for rack mounting. All necessary operating controls and appurtenances are mounted on this panel. The units contain no electronic equipment other than a single vacuum tube which serves the dual function of providing the necessary biasing potential and erasing head energization. All power (other than that required for the driving and rewind motors) is obtained from the Recorder Amplifier unit which connects to the Recorder through three multi-conductor cables secured to the Recorder. The weight of the Recorder is approximately 28 pounds with two tape reels and a full load of tape. The power requirements for driving either the record or rewind motors is insignificantly small.

6.52 Operating Controls

Figure 22 shows the panel of the Recorders with the magnetic tape in position for recording. The two tape reels are quite obvious, the right hand reel being the take-up, i.e. the tape moves from left to right when recording or playing back. In the center near the top of the panel is the unit containing the "heads". Immediately to its right is the small drive capstan with the idler pulley above and to its right. The only controls for the Recorder are in the center of the panel below the heads. The middle switch controls the record and rewind motors: clockwise for record, counterclockwise for rewind, stop in the mid position. A small nickel plated latch below this control must be depressed before it can be moved to the record position. The control to the left determines the tape speed in two steps, fast or slow. The right hand control marked "Hi" is a spring return switch that, when depressed, moves the tape to the take-up reel at a somewhat higher speed without recording.

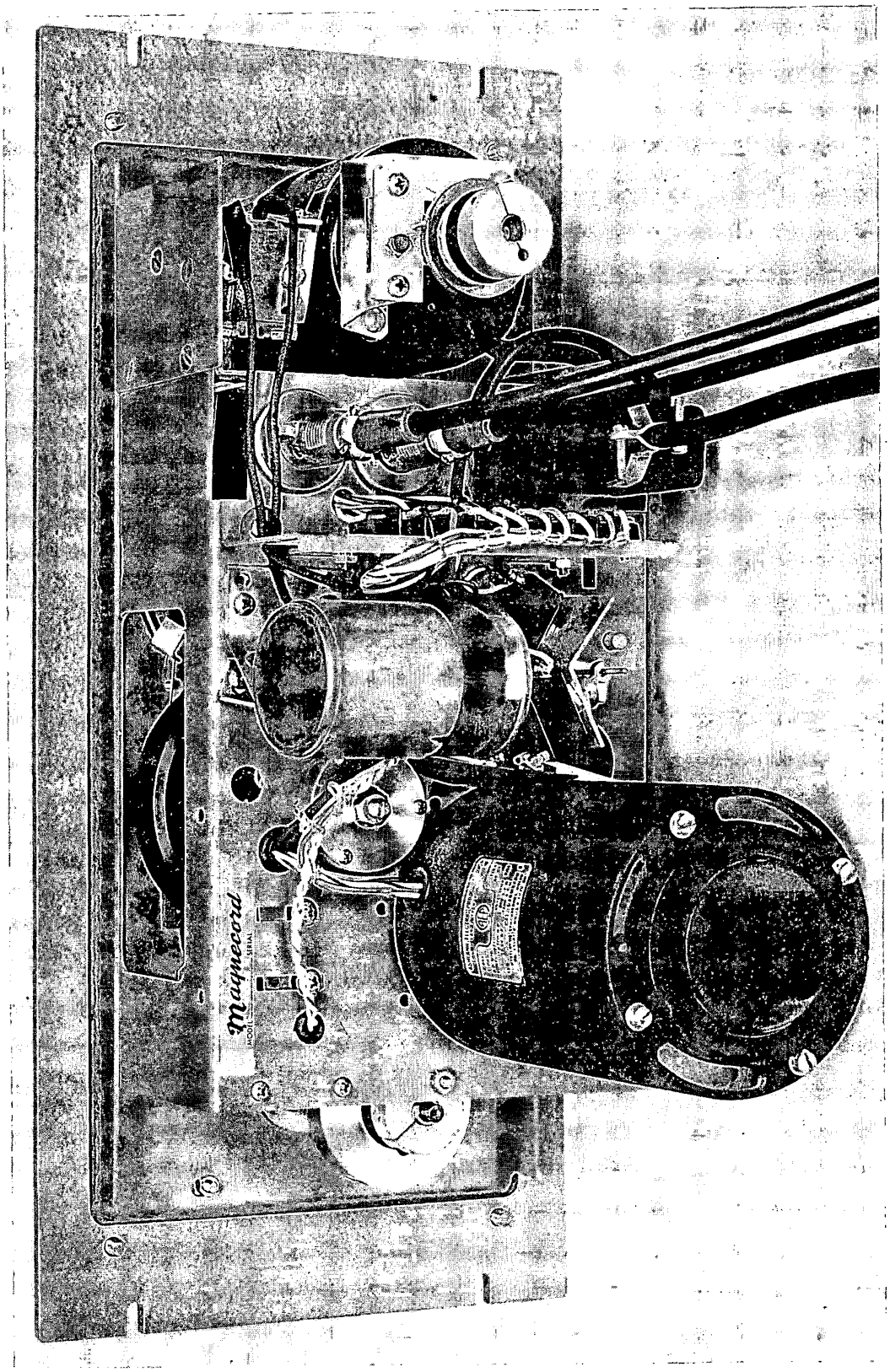


Figure 23 - The Recorder - Interior View

6.53 Tape Data

The tape used with this recorder is 1.5 mil acetate tape, 1/4 inch in width. Each reel holds 1200 feet. This is sufficient for a recording time of slightly more than one hour at slow speed or slightly more than one-half hour at high speed.

6.54 Tape Drive Mechanism

The tape is actually pulled across the heads by a rotating capstan which engages the tape through the friction between it and a pinch roller. The tape speed is determined by the diameter of this capstan and the speed at which it is rotated. These capstans can be obtained in different sizes so that variations in tape speed may be obtained for the same motor speeds. The capstans furnished with the Recorders are of such diameter as to provide for a "slow" recording speed of 3.75 inches per second and a "fast" recording speed of 7.5 inches per second.

6.55 Drive Motors

The recorders contain two drive motors, one for tape pulling, which drives the capstan and a second for fast rewinding which drives the feed reel. The capstan drive motor is of the dual-speed hysteresis synchronous type operating at either 900 or 1800 rpm at 60 cycles depending on whether the recorder is in the slow or fast condition. Friction drive, employing rubber "pucks" is used for connection between the motor shaft and the capstan. In addition to driving the capstan, this motor also drives the take-up reel through an additional friction drive and a friction clutch to maintain tape tension as the diameter of the tape roll changes. The rewind motor is an ordinary small induction motor operating at approximately 1750 rpm at 60 cycles, friction-drive coupled to the feed or rewind reel through an additional friction clutch. See Figure 23.

6.56 Fifty-Cycle Operation

While the capstans furnished for most of the equipments are the proper size to give the required tape speeds with the motors operating on 60 cycles; should these motors be operated on power of a markedly different frequency, the tape speed would be adversely affected. Accordingly, for those equipments that are intended for 50-cycle operation (a frequency at which the motors will operate satisfactorily but at a reduced speed) the recorders have been equipped with capstans approximately 16% larger in diameter.

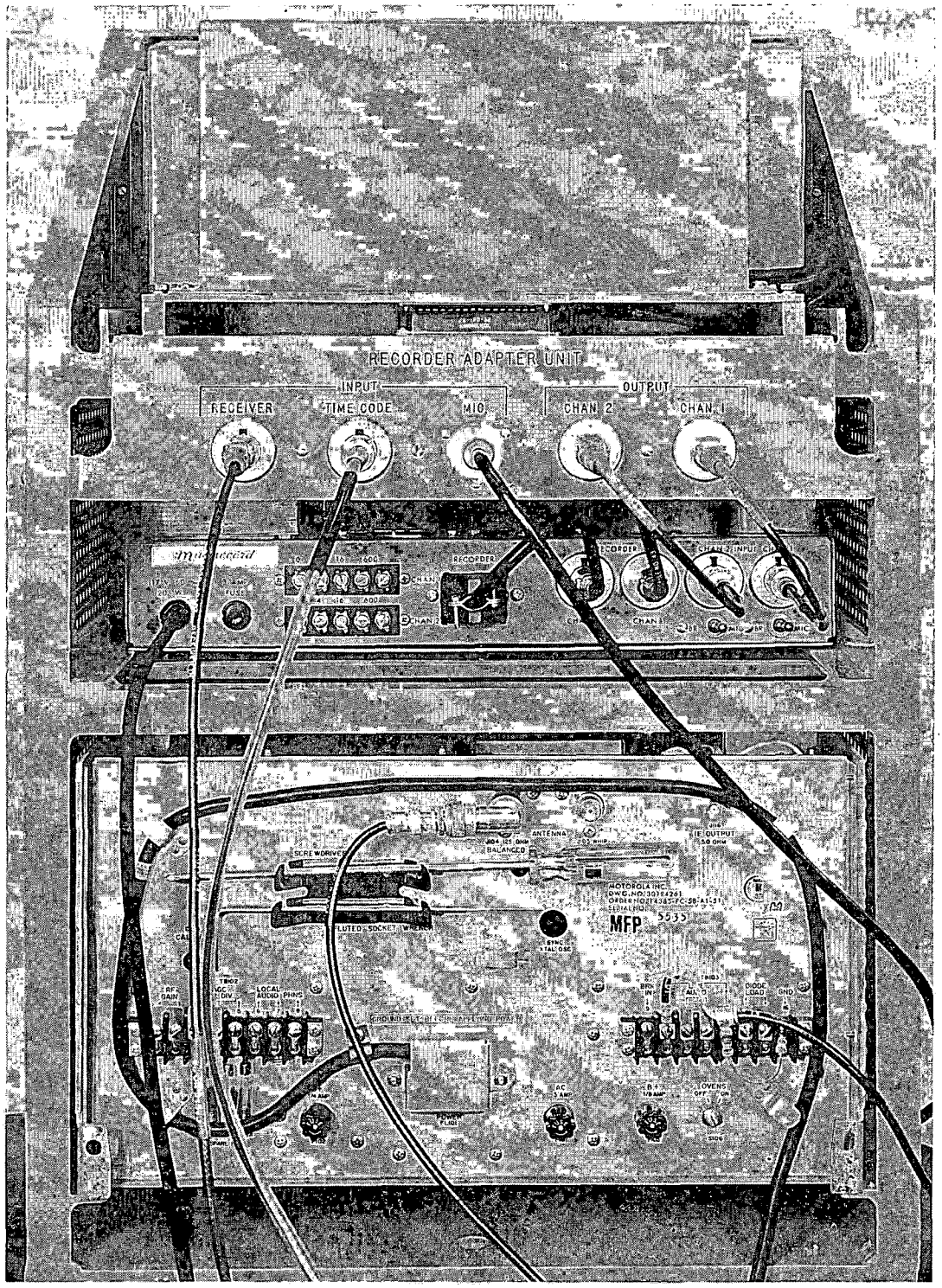
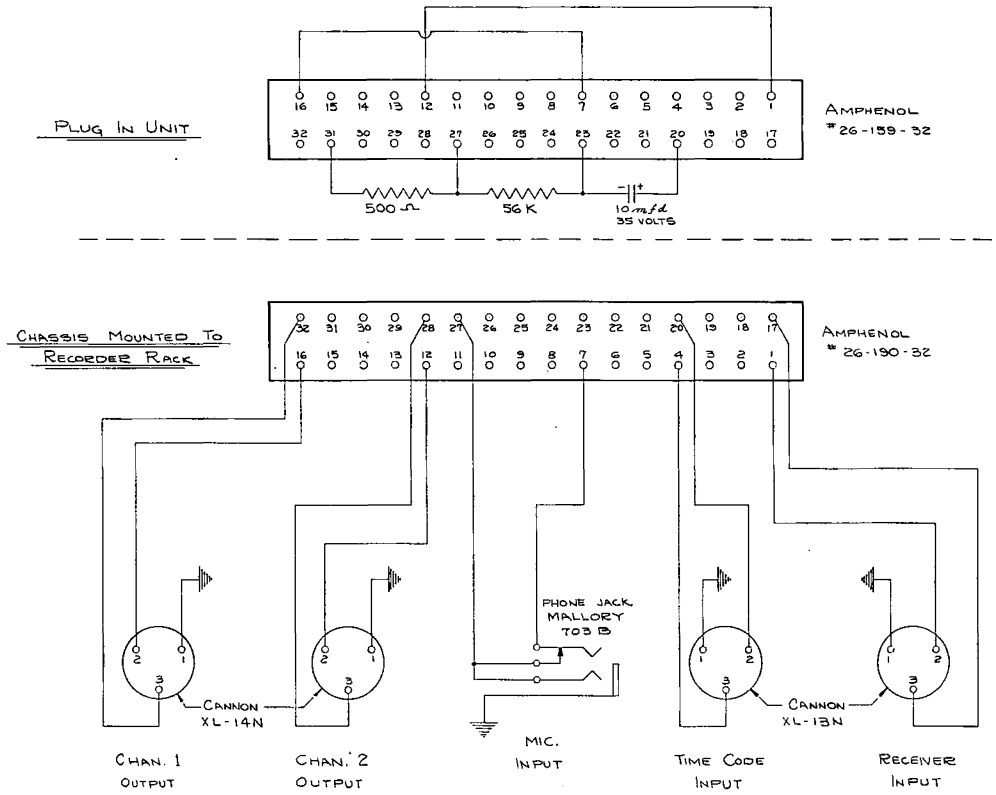


Figure 24 - The Recorder Adapter Unit as Mounted



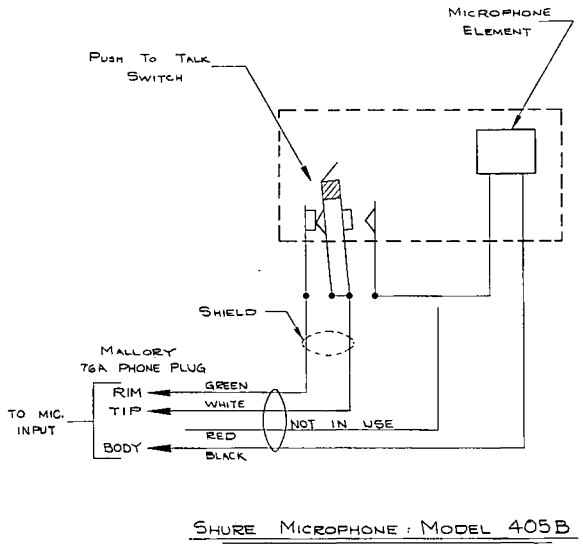


Figure 25 - Schematic Diagram of Recorder Adapter Unit

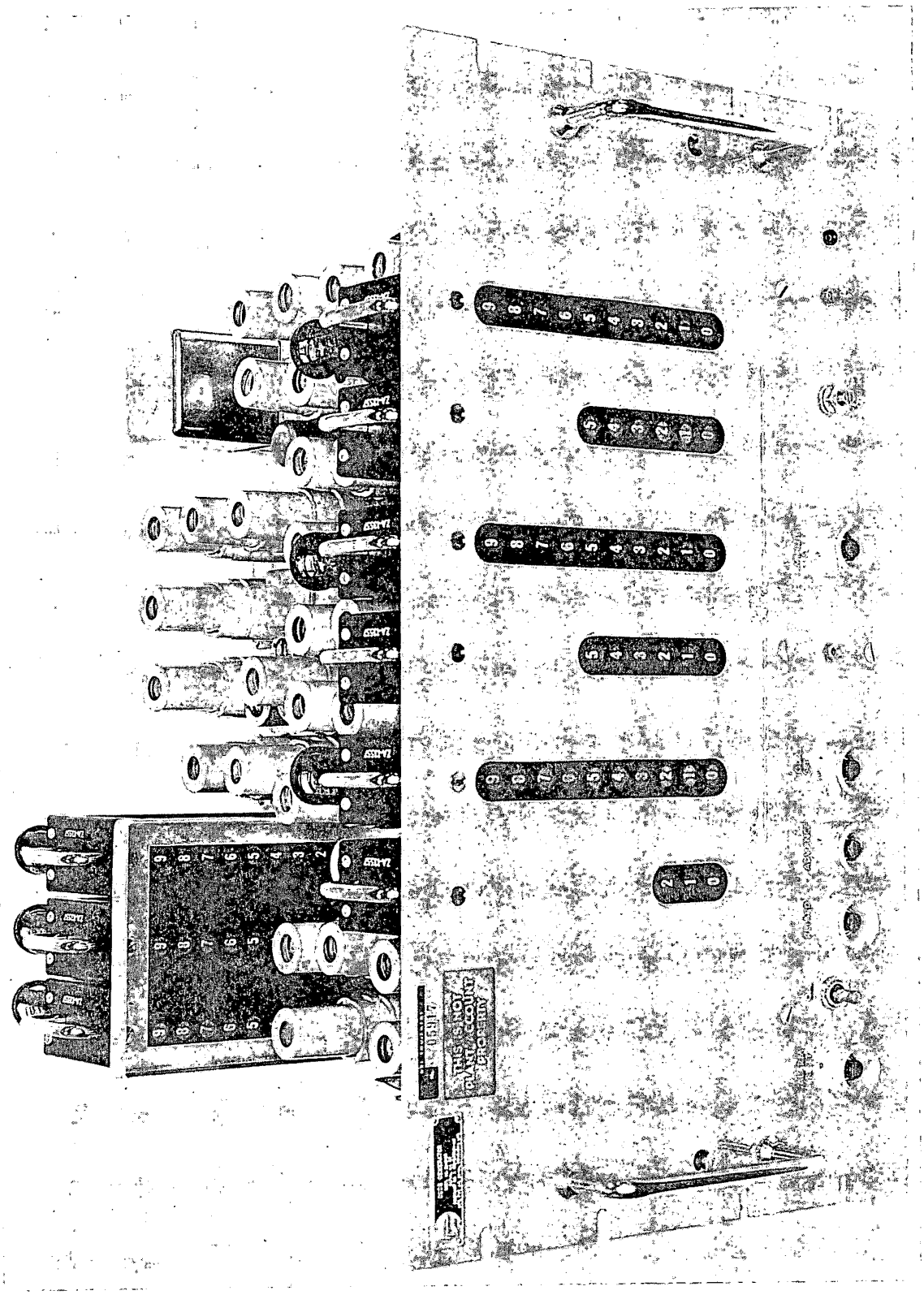


Figure 26 - The Time Code Generator

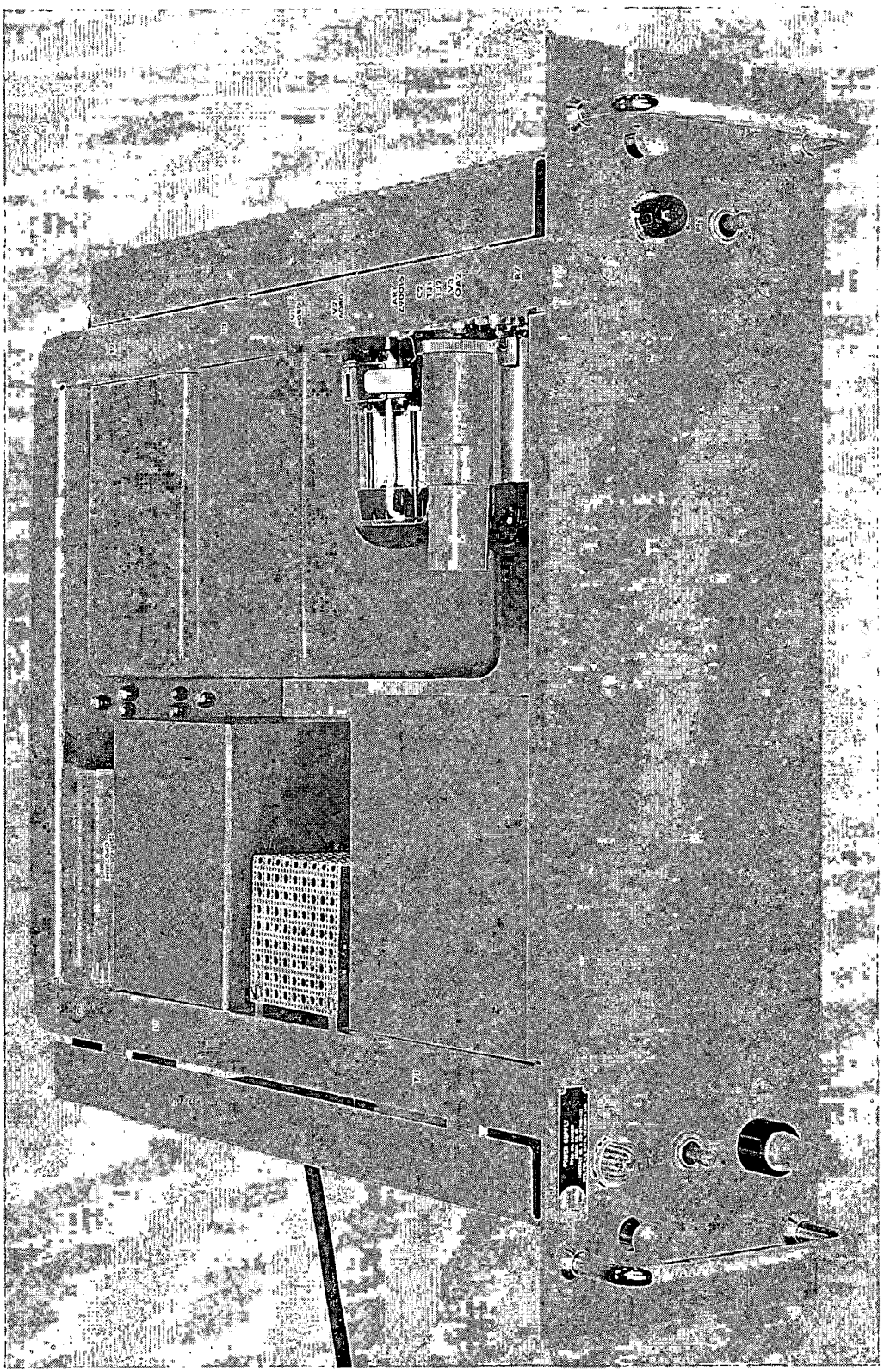


Figure 27 - The Time Code Generator Power Unit

6.6 THE RECORDER ADAPTER UNITS

The Recorder Adapter Unit is mounted behind the Recorder and is bolted to and carried by the Channel B rack. It is shown in Figure 24. It consists substantially of two sub-units secured together, a rather narrow strip unit containing five receptacles with a metal rectangular container secured to and above it and connected to it by a multiple-contact plug and jack. Fundamentally, as furnished with the equipments, this Adapter unit serves primarily as a cross-connection block to permit connecting the Recorder to its amplifier and the receivers and Time Code Generator, as well as the hand microphone. The schematic wiring diagram of this unit is shown in Figure 25.

The purpose of the large container and multiple contact plugs with so little equipment involved, is to provide maximum flexibility for future changes or improvements in the recording system by the inclusion of special filters. The large container has been provided to house such filters or other appurtenances should it be found necessary or desirable to supply them at a later date.

6.7 THE TIME CODE GENERATORS AND POWER UNITS

6.71 General

The Time Code Generator is an electronic device that permits the recording of the time of day in hours, minutes and seconds on one track of a magnetic tape in such form that upon play-back, the exact time of occurrence of any phenomena, the record of which is on the other track, may be observed. The device is one of a complete system of five units developed and manufactured by the Electronic Engineering Company (EECO) of Santa Ana, California and covered in detail in their Instruction Manual (covering all five units) which will be made available to the activities receiving the Facilities described herein. Only the Time Code Generator ZA-19135 and its Power Unit ZA-19263 are supplied with these facilities. Figures 26 and 27 are oblique front views of these units. In view of the completeness of the Instruction Manuals of the manufacturer, these units will not be described in great detail here but will merely be described briefly for the benefit of those who might be familiar with their principle of operation and not have their Instruction Book available.

6.72 The Time Code Generator

The basic time standard employed in this generator is a 100-kc temperature controlled crystal. The output from this crystal is divided down through a multiplicity of multivibrator or "flip-flop" circuits in such a manner that eventually time marks for hours, minutes and seconds are derived for modulating a steady carrier frequency. It is this modulated carrier frequency that is recorded. The carrier frequency in these instruments is 100 cycles. The time intelligence is placed on this carrier in the form of a "binary" system with the binary marks appearing as increases in the amplitude of the particular cycle of the carrier involved. The complete time in hours, minutes and seconds, in this order, is supplied for recording every second, the complete group requiring approximately 800 milliseconds. In addition, one-second markers are supplied. In addition to supplying the modulated carrier for the continuous recording of the time in the binary code, the unit carries behind its panel rows of gaseous discharge counter tubes which indicate the time visually in hours, minutes and seconds. These may be seen in Figure 26.

As will also be noted from this figure, the Time Code Generator is of "unit" construction, most of the divider and flip-flop circuits plugging into tube sockets with the tubes mounted above. The entire chassis slides into its rack in such manner that it may be slipped part way out and tilted up or down for easy servicing.

6.73 The Time Code Generator Power Unit

The power supply for the Time Code Generator is a separate and distinct unit and mounts in a rack below the operating table. Figure 27 is an oblique front view of this unit. As in the case of the Generator, this unit is well covered in the manufacturer's Instruction Manual and accordingly will not be described in great detail here.

This power unit is more or less orthodox in its electrical design, supplying all the required heater voltages in addition to a well filtered and electronically regulated high voltage supply of 200 volts, with means for adjusting this voltage to its proper value as the characteristics of the "voltage reference" tube might vary with age or change of tubes. It should be mentioned

that the Time Code Generator requires a reasonably well regulated "B" supply for its accurate functioning. The power unit supplied provides for such regulation with variation of line voltage between the limits of 100 and 135 volts.

Because of the dependence of the Generator on accuracy and stability of its "B" supply voltage for proper functioning and the fact that the regulation of this supply becomes ineffective below a certain minimum line voltage, the unit, as designed and supplied by the manufacturer, is equipped with an alarm system that sounds and locks-in a buzzer when the line voltage drops below a certain value. This value is stated in the manufacturer's Instruction Book as 100 volts. However, the basic relay (K2) that operates this buzzer through a secondary relay (K3) locked in by the "B" voltage is a thermal device and in practice has been found to be relatively unreliable and inaccurate and vary from equipment to equipment, often operating well above the line voltage value at which the regulator is still operating effectively. Unfortunately, the design is such that once this alarm buzzer is "triggered" (and its sound is quite raucous), there is no way of stopping it, short of increasing the line voltage (which is impractical) or shutting down and re-energizing the unit (which will lose the time accuracy). Furthermore, the alarm system, being thermally operated, is quite slow in its action and will not sound a warning for rapid line surges which could introduce time errors. Accordingly, in the Time Generators furnished with these facilities, the lock-in relay (K3) has been removed from its socket, thereby disabling the alarm circuit. This relay has been shipped with the spare tubes in the event that the alarm system might be considered useful at a later date or as a spare for relay K1 which is of the same type. It can readily be replaced in the vacant socket beneath the chassis near the rear on the right hand side.

SECTION 7

PRINCIPLES OF OPERATION

- 0 -

7.1 GENERAL

The facilities provided by the electronic equipment described herein are intended to permit the reception of scientific intelligence transmitted by various satellites encircling the earth as well as the recording of such intelligence on magnetic tape for future and more leisurely analysis and the association of such intelligence with the time of its reception. Because of the distances involved, as well as the low power of the transmitters, it is of paramount importance to achieve the very maximum in the sensitivity of the radio receiving equipment. However, aside from this and the mechanical arrangement of the various units involved, there is nothing particularly unique in the equipment provided.

Basically, there are two complete, separate and distinct receiving systems provided from the antennas on down so that signals from two different transmissions on two different frequencies may be received simultaneously. Provisions are also made for recording the intelligence from either source (but not both at once). In addition, provisions are made for the reception of time signals for setting and adjusting the Time Code Generator.

7.2 THE YAGI ANTENNA ARRAYS

These have been described in detail elsewhere in this Manual. Inasmuch as they are both fixed elements (as far as frequency coverage is concerned) and require no operating adjustments and the principle of operation of Yagi antennas is well known, little need be said with respect to the antennas in these particulars. It was considered both mechanically and operationally impractical to provide for the orientation of the antennas in two planes, so that, in order to provide for the maximum coverage in elevation, both antenna arrays are tilted upward 15 degrees while horizontally they are capable of being rotated through 520 degrees of azimuth. The electrical characteristics of the two arrays have been described earlier in this Manual except for their respective frequency coverage.

7.3 THE RECEIVING SYSTEMS

The two receiving systems are identical except with respect to their operating frequencies, so that one description of their Principles of Operation will serve for both. Fundamentally, they are superheterodyne receivers employing multiple conversion with all conversion oscillators crystal controlled except for the final conversion oscillator (which covers only a one-megacycle range) and the beat frequency oscillator, both of which are highly stable, continuously variable units.

Actually each receiving system is a composite arrangement consisting of standard R-390A/URR radio receivers used essentially as Intermediate and Audio Frequency amplifying units, preceded by additional r-f amplifiers and converters (designated Converter Units). These contain the first crystal controlled conversion oscillators, producing output frequencies that fall within one specific band of the R-390A/URR receivers. The first conversion crystal frequencies are different for each installation but are so chosen that the output frequency feeding the receivers proper is the same for the two different input frequencies involved. Thus, assuming that all equipments are operating properly, it is only necessary to set the R-390A/URR receivers to the frequency assigned for each installation and the systems will be in condition for the optimum reception of both of the radio frequencies involved.

In effect then, the system operates as any normal radio receiving system with the exception that "fine" tuning is accomplished by tuning the Intermediate Frequency, and the receiver dial calibrations indicate the value of the Intermediate and not the incoming radio frequency. A more complete description of the Converters and R-390A/URR receivers is contained in a previous section of this Manual and need not be repeated here.

7.4 THE RECORDERS

In order to make a semi-permanent record of any intelligence that might be received and be worthy of recording, a Tape Recorder is provided with means for switching one of its inputs to the output of either receiver. This recorder is of the two-channel type, provided with a dual amplifier so that two channels

may be recorded simultaneously. One channel is for the recording of received intelligence while the second is intended for the recording of timing information. In addition, a hand microphone is provided to permit the operator to annotate the tape with comments on the reception, additional time information or other pertinent data. Tape recorders are so universally common and their principle of operation so well understood that any additional information on their operating principles here would be redundant.

7.5 TIME DATA

Time data can be recorded on the recording tape by two methods. For general information such as the date or possibly the hours and minutes, voice information from the operator may be recorded. However, a Time Code Generator is included as part of the installation, permanently connected to the input of one of the recording channels, excepting when the "push-to-talk" button on the hand microphone is depressed for the inclusion of voice information from the operator. Therefore, unless this channel is deliberately de-energized, time information is automatically being recorded at all times recordings are being made. These time data from the Time Code Generator are in the form of hours, minutes and seconds in the form of a binary code, changing every second. One-second marker "pips" are additionally provided.

7.6 STANDARD TIME SIGNALS

In order to permit the checking of the accuracy of the timing information from the Time Code Generator, a coax switch is provided on the Channel B Converter assembly that permits the input of the Channel B receiver (R-390A/URR) to be disconnected from the Converter output and connected to the output of the twenty-five-foot whip antenna. Under this condition, the R-390A/URR functions as a standard high frequency receiver within the frequency range of 0.5 - 32 megacycles for the reception of time signals from any station transmitting them that is receivable. In order to increase the effectiveness of this antenna, it is provided with a counterpoise seventy feet in diameter and with a matching unit that permits the obtainment of a "match" to its transmission line at 10, 15, and 20 megacycles, or to use it at slightly decreased effectiveness at any lower or higher frequency.

SECTION 8

ASSEMBLY AND INSTALLATION

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8.1 THE HUTS

8.11 Shipment Status

In order that the entire shipment of all facilities be complete without using excessive shipping and space and at the same time assuring the minimum possibility of damage to any of the electronic equipment, practically all of this equipment has been removed from the mounting racks and boxed separately, the boxes being secured within the huts. Similarly, all the antennas have been disassembled, the parts packed separately and also stowed within the huts. The huts have been designed, as indicated by their trade name HELIHUT, for transportation by helicopter slung from a four piece bridle secured to lifting eyes on each of their four corners. This is the safest and most satisfactory way of moving these huts, i.e. (Not by helicopter) but by the use of a crane or similar device lifting on the lifting bridle. For this reason the huts have been shipped with the bridle secured atop each structure.

8.12 Methods of Handling

The design of these huts is such that their weight is taken by three hollow aluminum floor joists or beams running longitudinally, one in the center and one about six inches in from either side. In many cases it has appeared that fork lifts are ideal for moving these huts. While, as stated in 8.11 above, the safest method is by lifting with the bridle provided for the purpose, if any attempt is made to use a fork lift or any other method of handling, EXTREME CARE SHOULD BE EXERCISED NEVER TO TAKE THE WEIGHT OF THE HUTS ON ANY OF THEIR SURFACES OTHER THAN THE THREE FLOOR BEAMS. The sheathing, including the floor, is of relatively thin aluminum and can be easily punctured by the prongs of a fork lift or other sharp object.

8.13 Preparation of Site

While the huts themselves only occupy a ground area of some fifty square feet, the vertical antenna for receiving time signals or other communications employs a circular counter-poise system approximately seventy feet in diameter and the hut guys (if used) will require an additional six or eight feet, so that a

cleared area approximately 70 x 90 feet will be required for the facilities. The huts themselves should not be set directly on the ground but should be supported by wooden footings, such as 6" x 6" timbers approximately six feet long laid transversely so as to catch all three floor joists. At least two and possibly three such footings should be provided, the two near the two ends of the huts being located some foot or so from the ends, inasmuch as the ends of the three floor beams are tapered near their ends. While it is realized that there is often little choice, whenever possible the site should be chosen not too close to electrically disturbing sources or tall structures but at the same time must not be too far removed from a suitable source of power.

8.14 Placing the Huts

The huts should be placed on their footings and shimmed up so as to be substantially level. This not only assures more pleasant operating conditions but removes some strain from the antenna rotating gear. It is not essential that the huts be faced in any particular geographical direction (the relationship of the antennas and their azimuth scale can be adjusted after their installation). It is possible that the choice of their heading will be determined by the position of the door with respect to prevailing weather conditions or similar factors.

8.15 Guying the Huts

After the huts have been permanently placed on their footings and properly shimmed, the lifting harness should be removed from the lifting eyes and the four cables with their turnbuckles removed from the lifing ring. It will be found that the hooks that secure the cables to the four corners of the huts have had light bars welded across their "keepers" to prevent easy pilfering during shipment. These can be broken off to remove the hooks, as they have served their purpose. The four cables are then suitable and intended for use as guys to prevent the huts from tipping or shifting under the influence of heavy winds. The four cast corner fittings of the huts are provided with eyes below the lifting eyes, plainly marked "Guy Here" to which the guys may be shackled and extended to "dead-men" or stakes buried in the ground at a suitable distance from the huts. No "dead-men" or stakes are furnished but four heavy eye-bolts are supplied for screwing into the anchorages used.

8.2 UNPACKING OF HUTS AND EQUIPMENT

IT IS STRONGLY RECOMMENDED THAT THE DOORS OF THE HUTS NOT BE OPENED UNTIL AFTER THEY ARE PERMANENTLY SET ON THEIR FOUNDATIONS AND GUYED IN PLACE.

8.21 Removal of Equipment from Hut

After the door of the hut has been unlocked and opened, it will be found that practically the entire interior is filled with packing boxes and cartons containing the various component units or items which have been removed from their normal mounting positions or disassembled for safe shipment. The walls of the hut have been lined with plywood nailed to 2 x 4 studs which rest against them on padding to preclude scratching the paint. There may even be a section of plywood part way up the entrance end to protect the door. This plywood lining was put in to afford protection to the walls in the event of a cargo shift during transportation. Even the rubber floor mat has been removed and packed separately for its protection.

Inasmuch as at the time of writing the exact position of each item or its order of packing is not known, it is impossible to give detailed instructions as to any order of unpacking. This should be readily determined on a trial and error basis.

Certain of the items, such as mast sections, cables, etc. are not as amenable to damage as the delicate electronic equipment that has been carefully adjusted and tested prior to packing and shipment. It is highly desirable that these items be handled as little as possible after unpacking.

IT IS THEREFORE STRONGLY RECOMMENDED THAT THE UNPACKING PROCEDURE BE DONE IN GOOD WEATHER SO THAT THE VARIOUS BOXES MAY BE OPENED ON THE SPOT AS SOON AS EACH HAS BEEN REMOVED , RATHER THAN TAKING THEM TO A STORE HOUSE AND LATER BACK TO THE HUTS.

8.22 Unpacking of Units

After all the various boxes, cartons, etc. have been removed from the huts, the "dead material; such as antenna parts, cables, tools, spares, etc., should be put to one side for later use and the boxes of Electronic Equipment examined for the markings of their contents. A nail puller has been included in each hut to assist in the unpacking. The intent should be to unpack each unit and get it into its rack with the least possible handling and exposure to the weather. Therefore, unpack each box containing an electronic unit progressively and as it is removed from its box carry it immediately into the hut and slide it temporarily into the rack provided for it. In certain of the racks, the interconnecting cables have been taped to the guides to hold them in place during shipment. Clear those cables and push out of the way to accommodate the units. Do not be concerned about the attachment of any cables to their units at this time; this can be done later. It is suggested that the following order of unpacking will be found most advantageous:

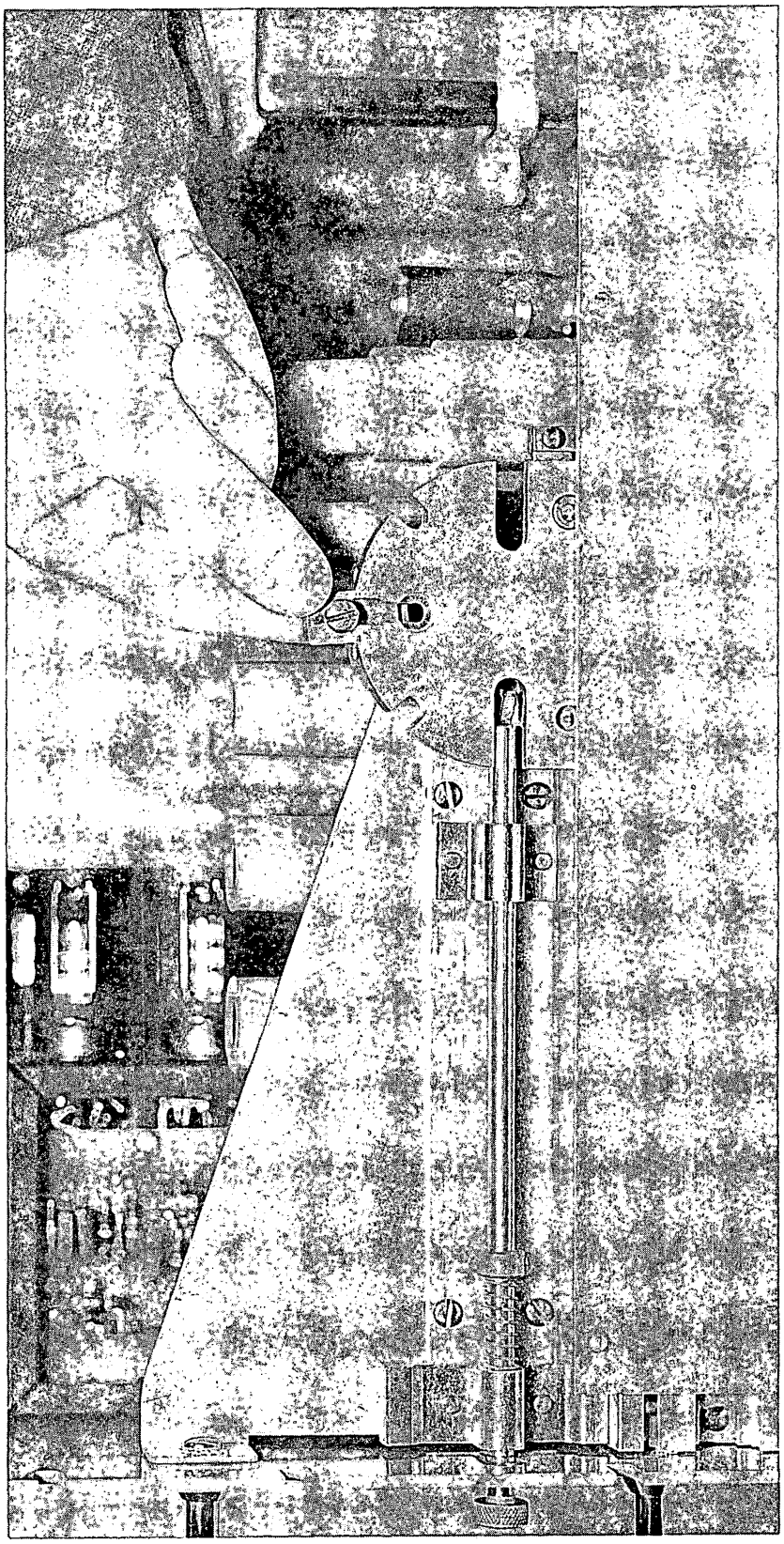

Figure 28 - Time Code Generator Sector
Detent Mechanism

CHANNEL A RECEIVER
CHANNEL B RECEIVER
TIME CODE GENERATOR
RECORDER AMPLIFIER
RECORDER
TIME CODE GENERATOR POWER UNIT
CHANNEL A CONVERTERS
CHANNEL B CONVERTERS

8.23 Location of Units in Their Racks

There will be found to be two racks on the Operating Table, to the left and right of the Antenna rotating hand wheel and azimuth scale respectively, and one three-tier rack below the Operating Table extending to the deck. The various units of the equipment fit into these racks in the following order:

CHANNEL A RECEIVER----------Lower section of left hand rack on table.
CHANNEL B RECEIVER----------Lower section of right hand rack on table.
TIME CODE GENERATOR----------Above Channel A Receiver.
RECORDER AMPLIFIER----------Above Channel B Receiver.
RECORDER----------Above Recorder Amplifier.
TIME CODE GENERATOR POWER UNIT----Lower section of left hand rack below table (next to deck).
CHANNEL A CONVERTER----------Middle section of left hand rack below table.
CHANNEL B CONVERTER----------Top section of left hand rack below table.

8.24 Mounting of Time Code Generator

Before the Time Code Generator can be placed into its rack, certain preparations of the rack and Generator chassis are necessary.

1. Remove the tape from the slides of the rack and pull the slides forward.

2. Loosen the screws in the retaining blocks in the center of each sector-detent assembly and remove these blocks (See Figure 28).

3. With the front panel horizontal and facing upward, lower the unit between the slides, engaging the T-shaped pivot pins into the slots from which the retaining blocks were removed.

4. Replace the retaining blocks and tighten the screws holding them in place.

5. Pull outward on the two knurled knobs beneath the handles on the front panel and rotate the unit chassis to its normal position.

6. Push on the knurled knobs and slide the chassis into its rack.

8.25 Mounting of Time Code Generator Power Unit

Care must be taken in handling the Power Unit of the Time Code Generator and certain preparations must be made before it can be placed in its rack.

1. In removing the unit from its packing box either lift out with the panel toward you or lift by the front and rear panels to prevent the unit sliding off its guides.

2. Remove the tape securing the drawer slides and place the unit in front of its rack.

3. With the drawer slides extended a few inches, move the unit so that the holes in the far end of these slides are aligned with the holes in the shim plates fastened in place on each side of the rack.

4. Fasten the drawer slides in place with the 10/32 binder-head machine screws provided for the purpose.

5. Pull the unit out of its rack as far as the slides will permit and raise the front panel to align the two holes in the front end of the slides with matching holes in the shim plates. Secure the top holes only, with the 10/32 machine screws provided.

6. The unit may now be pushed into its rack by means of the knurled knobs provided.

8.26 Preparation for Antenna Erection

After all the various electronic equipments have been unpacked and temporarily stowed in their respective racks, the empty packing cases should be removed inasmuch as a clear working space all around the huts will be required for the assembly and erection of the antennas, the next step in the assembly procedure.

8.3 ASSEMBLY AND ERECTION OF VHF ANTENNAS

8.31 Description of Antennas

The VHF antenna system consists of two separate and distinct Yagi arrays, mounted on a tubular mast extending through the roof of the hut near one end and capable of being rotated from within the hut through an angle of approximately 520°. Both antennas are intended for the reception of vertically polarized signals and are mounted one above the other, pointing in the same direction and tilted at an angle of 15°. The upper antenna consists of a two bay array while the lower is a four bay array. The mast, for purposes of shipment, is in three sections and requires assembly as part of its installation. Within the hut is a pedestal containing reduction gears, an operating handwheel and an azimuth scale, as well as a hand brake for locking the antennas in position. Inasmuch as the assembly of the mast and antenna system must start with the operating pedestal, a brief description of this item is included in the following.

8.32 The Antenna Rotating System

The antenna rotating system located inside of hut consists of a handwheel (modified automobile steering wheel), a 6 to 1 planetary gear reduction unit, an azimuth scale graduated with one degree markings, a pair of stops permitting 520° or approximately 1 1/2 turns of the center shaft or mast and a hand brake located on the underside of the Operating Table, about twelve inches to the right of the center pedestal. The handwheel when revolved will rotate the mast and the externally attached antenna arrays. The planetary gear reduction unit will permit easier turning of the antenna arrays under wind load. A 60° rotation of the handwheel will rotate the mast 10°. There is a slight amount of back-lash or lost motion in the gear reduction unit. This lost motion is inherent in the gear train and does not mean that parts are loose or slipping in the mechanism. The azimuth scale permits reading the azimuth position of the antenna arrays after the mast and arrays have been assembled and the azimuth scale set to a

true north reference. Inasmuch as the antenna cables rotate with the antennas, the internal mechanical stops prevent excess cable wind-up and damage. In the equipment as shipped, the azimuth scale has been arbitrarily set on 180°, so that the mast is capable of about 260° clockwise rotation and 260° counterclockwise rotation. After the azimuth scale has been set to a true north reference, this of course will no longer be true. However, the mast will still be capable of 520° rotation between stops as before. The hand brake is similar to that found on automobiles. The brake is "on" when pulled forward and "released" when rotated counterclockwise and pushed in or back. This brake will not only lock or hold the antenna arrays in a fixed or steady position, but by partially tightening, it may aid in restraining the natural rotational torque of the wind on the antenna arrays during operation.

8.33 General Assembly Instructions

Before starting the assembly of the VHF Antenna System, it is strongly recommended that the entire instructions that follow be carefully read in their entirety in order to get the "feel" of the whole procedure and that each section be reread before starting on the actual step-by-step mechanical work involved. If this procedure is followed and the work involved thoroughly understood, two or three men can complete the assembly and installation of the VHF Antenna System in three to four hours.

8.34 Preparation of the Antenna Rotating System

1. Release hand brake, if found "on", by twisting brake handle counterclockwise about 45° and pushing handle in.

2. Remove the black dust cover located immediately below the handwheel spokes of the antenna rotating system. The dust cover is split in two halves and can be removed by taking out the six screws around the bottom edge of the cover. A short screwdriver for this purpose is furnished in the Tool Box.

3. When the two halves of the dust cover have been removed, turn the handwheel of the antenna rotating system so that the two 3/8" diameter Allen-head set screws and the two white index lines in the top collar are most convenient to you. One set screw and index line should be 45° to your left and one set screw and index line should be 45° to your right.

4. With the 3/16" hex Allen-head wrench (from the Tool Box) back set screws out of the top collar so that your hand when placed inside the center 4" diameter bore or hole does not feel an inside protrusion from either screw.

5. There are a second set of two Allen-head set screws, circled in white, in line with the first set about 5" lower down. Back these two set screws out following the same procedure as the first set. Your hand when placed inside the bore or hole should not feel an inside protrusion from either screw.

8.35 Erection of the Mast

8.351 Removal of the Upper Mast Bearing Protective Cover:

1. Climb up three hinged steps on left front corner of hut to roof top and remove the 9 1/2 inch diameter top cover plate that is held in place by four 5/16" diameter bolts.

2. Set cover plate to one side and replace the four bolts to their original position and tighten. (The top cover plate served only as a rain protector for the upper mast bearing and for the hut equipment during shipment but should be retained, however, in case the equipment at a later date is transshipped to another station or returned to the point of origin.)

8.352 Installation of Lower Mast:

3. Lift the lower mast section on to the roof of the hut. The lower mast section can be easily identified, having two key slots milled into the tube on the lower end, a stainless steel sleeve and an aluminum weather cover near the top end. The top mounting flange is marked with the letter "A" and has eight equally spaced holes in it.

4. Stand the lower mast section vertically near the upper mast bearing or hole in the roof with the sleeve, weather cover and mounting flange up. The milled slots in the tube will be at the bottom or near your feet.

5. Lower the mast section through the upper mast bearing or hole in the roof. One man can lower the mast section while a second man is inside the hut guiding the mast section into the 4" diameter bore or hole in the antenna rotating system. CAUTION: the upper mast bearing is self-aligning and may have to be tapped with a hammer or the heel of your shoe to properly

align itself while the stainless steel sleeve is entering. A slight rotary motion may also help as the bearing sleeve enters and passes into the upper mast bearing.

6. The lower mast section will enter the antenna rotating system or table pedestal 10 3/16 inches and then hit a shoulder. Be sure the lower mast section is fully seated in the antenna rotating system. The man on the roof should then rotate the mast section until the key slots, in the mast, line up with the set screws and white index lines on the top collar of the pedestal. If the mast is properly seated, about 1/2 inch of milled key slot will be visible above the top collar. Tighten the four Allen-head set screws.

7. Replace the two halves of the dust cover and secure it with the six screws around the bottom of cover.

8.353 Orientation of the Lower Mast:

Because of the fact that the stops on the mast limit the rotation of the antennas to be secured thereto to approximately 520°, it is highly advantageous to have the antennas so angularly set on the upper mast section that when they are pointing to the center of the average orbit of the satellite, the stops are approximately in their mid position, thereby providing for the maximum usable swing. It has been determined subsequent to shipment that this direction is 270° with respect to North. With this information now in hand, proceed as follows:

1. Set the azimuth scale on 180°.

2. Climb to the roof of the hut and make a chalk, pencil or scribe mark on the flange of the lower shaft with an arrow pointing in the direction with respect to North, of which you have been advised. This need be no more accurate than within plus or minus five degrees. If a compass is used in obtaining the direction for this mark, attention is directed to the fact that the lower shaft is of steel. The mark you have made on the shaft flange will probably fall between two bolt holes, but be closer to one.

3. Have someone in the hut rotate the shaft by the handwheel until the bolt hole nearest the mark you have made points away from the entrance end of the hut.

4. Apply the hand brake to the shaft.

8.354 Erection of Center and Upper Mast Sections;

1. Remove from ANTENNA PARTS BOX the bag of bolts labelled "Bag #1, Bolts for Assembling 3 Mast Sections Together and 2 Crossarms to Mast". This bag will contain twenty-eight bolts 3/8-16 x 1 3/4" long. (Twenty-three bolts are required.)

2. Lift center mast section to top of hut. This mast section can be identified as being the shorter and heavier of the two remaining mast sections. It has an eight-hole circular mounting flange that is marked with the letter "A" at the lower end and has a seven-hole circular mounting flange that is marked with the letter "B" at the upper end. Place this mast section lengthwise along the roof of the hut with the lower circular mounting flange marked "A" extending slightly over the aft end of hut edge. Rotate the mast section so the bolt heads on the steps are facing up and the nuts on the steps are facing down.

3. Lift the upper mast section on to the roof of the hut and match up mounting flanges marked "B", rotating upper mast section until the white index lines on flanges coincide. The heads of the bolts on the steps should face upward the same as the center mast section.

4. Bolt the two flanges together with seven of the bolts from Bag #1 (3/8-16 x 1 3/4" long). There are box wrenches in the Tool Box that fit the bolt heads and nuts.

5. Lift the curved hoisting arm to roof of hut and attach to top end of upper mast section. The piece of wood separating the two step halves is for shipping purposes only and should be removed and discarded. The hoisting arm with two welded half steps go on the upper side of mast tubing as near the upper cross arm mounting plate as possible, the detached half steps go on the underneath side of the mast tubing. The curve in the hoisting arm should now be toward the roof of the hut or toward the ground, and the steps should lie in line with the steps on the two mast sections.

6. When the hoisting arm is securely bolted to the mast, move the assembled mast sections forward along the roof of the hut until the lower circular mounting flange marked "A" is near the upper mast bearing and lower mast section.

7. Stand center and upper mast sections vertically in air with hoisting arm up and circular mounting flange marked "A" resting on roof of hut. Rotate this mast section until the nuts on the steps are facing aft end of hut. If correctly assembled up to this point, the hoisting arm and the rectangular offset lower cross arm mounting pad should also be facing the aft end of hut.

8. Lift the assembled center and upper mast sections vertically about fifteen inches high and place on top of lower mast section, being careful to maintain lower cross arm mounting pad and hoisting arm orientation facing away from the entrance. With one man holding mast steady, the second man should bolt the two flanges together with eight of the furnished bolts from Bag #1 (3/8-16 x 1 3/4" long).

8.355 Installation of Cables in Mast:

Remove from the container in which the r-f cables are shipped, cables #19 and #20. These cables can readily be identified by the square base receptacles on one end of each, colored red and blue respectively. Carry these cables to the roof of the hut. On the middle section of the mast just below the upper flange will be found a stepped fitting with two holes in it. Thread the cables through the holes. The red receptacle mounts in top hole. Push the cables down through the mast and have a man in the hut "fish" them out through the large oval opening in the left side of the pedestal. Secured to the face of each receptacle with four machine screws and nuts are rubber gaskets. Remove the nuts (one receptacle at a time) and secure the receptacles to the mast fitting by the screws already in the receptacles.

8.36 Assembly and Mounting of Two Bay Yagi Antenna

8.361 Mounting the Antennas to Cross Arm:

1. Unpack or otherwise select the two bay antenna parts. These antennas may be identified by the fact that they have three folded dipole driven elements (as compared to two for the four bay antennas and also have the longer reflector and director elements).

2. Assemble each antenna on ground by loosening the three screws holding the mounting base plate to the square tube, removing the two screws from the overhanging end of the mounting base plate, inserting other section of square tube carrying five directors into the mounting base plate. If you find the driven elements detached, assemble them on square tube starting with lE2 matching coding

numbers. After these are in place and base plate and tube index lines coincide, replace the two screws, securely tighten all screws and replace transmission lines.

3. Carry upper cross arm to the aft and alongside the hut and hold horizontally across knee with cross arm parallel to back wall of hut, with the two eye bolts facing up, the center mounting pad marked "C" facing down, and with the white index mark on the edge of the center mounting pad facing away from the hut. The antenna mounting pads at the ends of the cross arm will slope downward toward the hut at about a 15° angle.

4. Place an assembled antenna vertically polarized (elements vertical) on top of antenna mounting pad at end of cross arm so that the three driven folded dipoles are on the downward end of the antenna slope and the five directors are on the upward end of the antenna slope. The folded dipoles should be nearest the hut, the directors should be away from the hut.

5. Bolt antenna in place with four bolts from Bag # 2 (3/8-16 x 1 1/4" long).

6. Repeat procedure for securing second antenna to opposite end of cross arm. The upper cross arm and vertically assembled antennas will now support themselves on the ground. If properly assembled on the cross arm, the antennas will slope in the same direction, will have the driven folded dipoles of the antennas on the same side of the cross arm and will have the Type N r-f connector on each antenna facing in the same direction.

8.362 Connection and Waterproofing of Cables:

While the two-bay array is on the ground, two operations are to be performed together: (a) attaching the cables and (b) waterproofing all cable junctions.

1. From the cable box, select cable 10 (with a tee at the center), the ends of which are to be attached to the connectors on the dipoles of the two Yagi antennas mounted on the upper cross arm (see Antenna Cabling Diagram on Fig.29).

2. Remove plastic cap from dipole connectors, take tube of Silicone compound from Antenna Parts Box and insert a small amount of Silicone (about the size of a pea) in the outer ring space of a connector on cable 10 and press connector onto a dipole terminal and screw the clamping ring tight. The

Silicone is used to provide a moisture seal at the threaded junction in the connectors. CAUTION: SILICONE IS IRRITATING TO THE EYES. CLEAN HANDS BEFORE TOUCHING FACE.

3. Secure the cable under the two clamps on the antenna arm and, with a gradual bend, run cable along the cross arm with a turn or two around the cross arm to take up the slack so the tee will be near its center; similarly arrange the other half of the cable and connect to the antenna connector on the other end of the cross arm after inserting the Silicone.

4. Detach both sections of this cable (No. 10) at tee and apply Silicone to the male member and reconnect. DON'T ALTER THE LENGTH OF ANY CABLE IN THE HARNESS OF EITHER YAGI ARRAY, as their lengths are optimum for best electrical performance.

5. Connect cable 13 to center of this tee after applying Silicone as above.

6. As a final water-proofing operation, using electrical scotch tape from Antenna Parts Box, tape over all five cable junctions just made and extend the tape several inches along the cable. This Silicone and taping treatment is to be applied to every junction of the antenna harness and transmission lines outside of the hut, including both arrays. Four rolls of tape are provided.

8.363 Mounting Antenna System:

Rig the furnished block and tackle by hooking one block to the eye in top of hoisting arm on top of mast and one block in center ring of rope sling. Tie ends of rope sling to two eye bolts in upper cross arm so that the two sling rope ends are fairly taut. One man on the ground can easily lift the cross arm, with a second man climbing the mast and steadying the cross arm as it progresses upward. The man climbing the mast should wear the furnished safety belt. When upper cross arm reaches the top of mast, it is pulled on to its mast mounting pad marked "C" and bolted in place with four bolts from Bag #1 (3/8-16 x 1 3/4" long). Untie sling from cross arm eye bolts and unhook upper block from hoisting arm.

8.37 Assembly and Mounting of Four-Bay Yagi Antenna

8.371 Assembly and Mounting of Cross Arm:

1. Because of its length, it was necessary to design the cross arm holding the sections of the four-bay Yagi array in three sections to permit ready

shipment. Accordingly, you will find a long middle section and two tip sections that bolt to it. The bolts (3/8-16 x 1 1/4" long) are already in the two tip sections. Remove the four bolts, match letter "E" on one tip section to letter "E" on lower cross arm, rotate tip section until the white index mark on the side of each flange is in line and bolt securely together. Repeat procedure, matching letter "F" on the other tip section to letter "F" on lower cross arm, rotate tip section until the white index mark on the side of each flange is in line and bolt securely together. The four equally spaced antenna mounting pads should now lie in a plane or in a straight line.

2. Lift the assembled lower cross arm to the roof of the hut. Rotate cross arm until the center mounting pad marked with the letter "D" is facing down and the four equally spaced antenna mounting pads are facing approximately upward.

3. Keeping this orientation, lift cross arm about 5 1/2 feet high to the rectangular offset mast pad marked with the letter "D". Match the cross arm mounting pad marked "D" to the mast mounting pad marked "D". The side cutout in the cross arm mounting pad faces into the vertical mast. There are white index marks on the side of each pad to further assist you. When the lower cross arm is in place and the holes in the pad line up, bolt mounting pads securely together with four bolts from Bag #1 (3/8-16 x 1 3/4" long).

4. If upper cross arm and lower cross arm have been correctly assembled, the four antenna mounting pads in the lower cross arm should slope in same direction as the two antenna mounting pads in the upper cross arm. If assembly is correct, remove top hoisting arm from upper mast section. Stow hoisting arm near hut in case repairs or maintenance to the two-bay antenna might be necessary in the future.

8.372 Assembly of Antenna Elements on Cross Arm:

The four-bay Yagi array obviously consists of four Yagi antennas mounted on the cross arm. However, for shipment purposes, each of the four antennas has been broken into two sections which must be assembled into a complete single antenna. The two sections are fastened together by a square clamping device which also serves as the base plate by which the antenna is secured to the cross arm, seating on a pad, four of which are welded on to this arm. To assemble each of the four antennas proceed as follows:

1. Loosen the three screws holding the mounting base plate to the square tube.

2. Remove the two screws from the overhanging end of the base plate.

3. Insert the other section of the antenna into the base plate with the two index lines coincidental.

4. Replace the two screws that were removed and securely tighten all screws.

To assemble the four antennas to the cross arm, proceed as follows:

1. Examine the terminal boxes of the four assembled antennas. It will be noted that two are stamped with the number 11 and two with the number 12. Place the two number 11 antennas on the roof of the hut.

2. Rotate the handwheel until the azimuth scale reads 90°. This will place the cross arm longitudinally with the roof of the hut and provide working room for one half its length.

3. With bolts from Bag #2 (3/8-16 x 1 1/4" long) secure one of the antenna's mounting base plates to the cross arm pad nearest the mast. IT IS IMPORTANT THAT IT BE MOUNTED SO THAT THE FOLDED DRIVEN ELEMENTS BE AT THE LOW END AND THE FIVE DIRECTORS FACE UPWARD AT A 15° ANGLE.

4. Repeat this procedure, bolting the other antenna to the outer cross arm pad in a similar manner.

5. Place the remaining two antennas on the roof.

6. Rotate the handwheel until the azimuth scale reads 270°.

7. Bolt these two antennas to the cross arms in the same manner the first two were secured.

If the assembly is correct, the four antennas should be symmetrically arranged on the cross arm with all the Director elements facing upward at a 15° angle, and the receptacles on all outlet boxes should be facing in the same direction.

8.373 Connection and Waterproofing of Cables:

The four Yagi antennas mounted on the lower cross arm are now to be cabled together, as follows, to form the four-bay Channel B antenna array. Where color coding is provided on connectors, the color for this array is blue.

1. Take cables 11, 12, and 14 (each has tee at center) and the tube of Silicone compound to the roof of the hut.

2. Rotate the array to bring the cross arm lengthwise the hut, with the dipole terminal boxes, with the number 11 marked on them, over the roof for accessibility.

3. Connect cable 11 end fittings to these two dipole connectors, applying Silicone to the male terminals as detailed in paragraph 8.362 above for the two-bay antenna bridles.

4. Rotate cross arm 180° and connect cable 12 terminals to the two dipole terminals marked 12.

5. Connect end fittings of cable 14 to the tees at center of cables 11 and 12.

6. Detach one at a time the connectors at the three tees in cables 11, 12 and 14. Apply Silicone and tighten back in place. The cabling should now conform to the Antenna Cabling Diagram on Figure 29.

7. Tape all connections for watertightness as detailed in paragraph 8.362.

8.38 Connection of Antennas to Mast Fittings

The only final action now required to complete the installation of the entire Yagi or VHF antenna system is the connection of the leads from the harnesses of each array to the two receptacles previously mounted on the mast for this purpose, employing the Silicone treatment as done with the bridle connectors. The upper array connects to the upper or red colored receptacle while the lower array connects to the lower or blue colored receptacle. In connecting these cables to their receptacles, any undue slack should be taken up by wrapping the cables a sufficient number of turns around the mast and, if desired, taping or lashing it in place. The red connector is on the end of cable 13. The blue connector is the center of "T" in cable 14, no additional cable being involved.

After the connections are made to the mast receptacles, both receptacles should be given additional waterproofing by taping the receptacles and three or four inches of the cables with the tape provided for this purpose.

8.39 Adjustment of Azimuth Scale

The easiest method for referencing the azimuth scale to true north is to loosen the azimuth scale, point the antenna arrays toward the North Star or Polaris, rotate azimuth scale to "O" scale reading and reclamp. Sighting the antenna arrays on the North Star is rather crude and probably subject to an error of a degree or so; however, since the antenna arrays have about a 20° beamwidth, the method is simple and adequate for this equipment.

The azimuth scale is clamped in position by a circular plate on top of the azimuth scale and by eight equally spaced screws in this clamping plate. Loosen screws located in clamping plate on top of azimuth scale about 5/8 inch back from sloping scale edge. Rotate handwheel as required in order to reach and loosen all eight screws. When the screws are loose, the azimuth scale should rotate without the handwheel turning.

Go outside the hut and stand either on the ground or on the roof of the hut and sight along the top or side edge of the square center tube of one of the antennas or along the vertical director elements. The low end of the antenna having the driven folded dipoles should be toward you and the high end of the antenna having the directors should be toward the North Star. Rotate handwheel as required until the North Star is in line with antenna. Pull on hand brake to lock position of mast and antenna arrays.

Rotate azimuth scale until "O" reading on the azimuth scale is opposite the white marker line attached to pedestal casting in front of operator. Tighten the eight screws in clamping plate. Go outside of hut and recheck sighting of antenna on North Star. If nothing has shifted, the azimuth scale is now referenced to true north.

8.4 ASSEMBLY AND ERECTION OF WHIP ANTENNA SYSTEM

8.41 Assembly of Mounting Legs

1. Select level spot about forty feet away from the hut. Carry the four aluminum H beam legs to selected spot and space legs 90° apart with pointed ends almost touching at the center. Place welded base structure on top of legs

over the center point so that the four channels in the welded base structure line up with the four H beam legs.

2. Remove from the PARTS BOX, "Bag #3" containing 28 bolts 1/2-13 x 1 1/2" long (24 bolts required). Move legs or base slightly as necessary to line up holes. Place bolts from Bag #3 through holes, place on lockwashers and nuts and hand tighten only.

3. Loosen 3/8-16 x 1" long bolt holding short aluminum ground bar on right side of bottom flange on leg. Remove 3/8-16 x 1" long bolt from left hand side of bottom flange of adjoining leg and discard the wooden block. Swing aluminum ground bar out 90° and bolt free end to adjoining leg using the 3/8-16 x 1" long bolt just removed. Hand tighten bolt only.

4. Repeat procedure for other three aluminum ground bars. When the twenty-four bolts are in the leg-base connections and the four ground bars are bolted in position, tighten all bolts with a wrench.

8.42 Assembly and Mounting of Antenna

1. Remove the 1/4-20 x 1 3/4" long stainless steel bolt and elastic stop nut from the feed-through stud on the insulator on top of welded base structure.

2. Assemble the three piece 25-foot whip antenna horizontally on the ground. Screw the three sections together and tighten the locking screws on the side of each tube section.

3. Stand the assembled 25-foot whip antenna vertically with largest diameter tube section on the ground. Pick up whip antenna and mount on stud in the insulator at the center of the welded base structure. Rotate whip antenna until the hole in the side of the tube lines up with the hole in the stud. Insert the 1/4-20 x 1 3/4" long bolt, screw on the elastic stop nut and tighten with a wrench.

8.43 Assembly of Counterpoise System

1. Remove from the PARTS BOX the 600-foot coil of number 12 bare copper wire, a cardboard box containing eighteen iron stakes (sixteen required) and an envelope containing twenty-four ground lugs (sixteen required). Remove from the Tool Box the wire lug-crimping tool.

2. Crimp a wire lug on the end of the wire on the 600-foot coil of number 12 bare copper wire. Secure wire lug to a number 10-32 screw in the ground bar.

3. Roll coil of wire out radially from the whip antenna to a distance of thirty-five feet. The direction can be closely estimated by sighting. The coil of wire in your hand, the far end of wire with the ground lug and the center of the whip antenna should be in a straight line.

4. Cut off wire from coil, loop cut end through a stake, pull wire taut, and drive stake in ground with hammer from Tool Box.

5. Repeat procedure for other fifteen required counterpoise ground wires.

6. If properly installed, all wires will fan out radially from whip antenna at approximately equal distances of fourteen feet between end stakes.

7. Attach the fifty-foot-long r-f cable marked "Whip Ant." to the r-f connector on the whip antenna base and to the r-f connector on outside of hut to left of door.

8.5 PLACING OF HUTS IN OPERATING CONDITION

As has been mentioned and as will be apparent to a recipient of any of the huts, it was necessary, in order to assure safe shipment of the various units required for each facility and to pack all the units within the huts, that their interiors be rather thoroughly stripped and protective coverings be installed for the walls and decks. Because of this, a moderate amount of work will be required in putting the huts back in their designed condition and reconnecting the various units, etc.

8.51 Refurbishing the Interior

1. Remove all the plywood protective sheathes by pulling the nails with which they are secured to their studdings, after which they can be carried through the door in sections. The studs are not secured but merely rest in place against padding, so that when the plywood is taken down these can also be readily removed.

2. Sweep out the huts to remove any accumulated dirt or trash.

3. Replace the work table in the corner of the hut to the left of the door (as entered). This is merely screwed to the deck and bulkhead using the same holes from which the screws were withdrawn. The screws are in a small bag attached to a table leg.

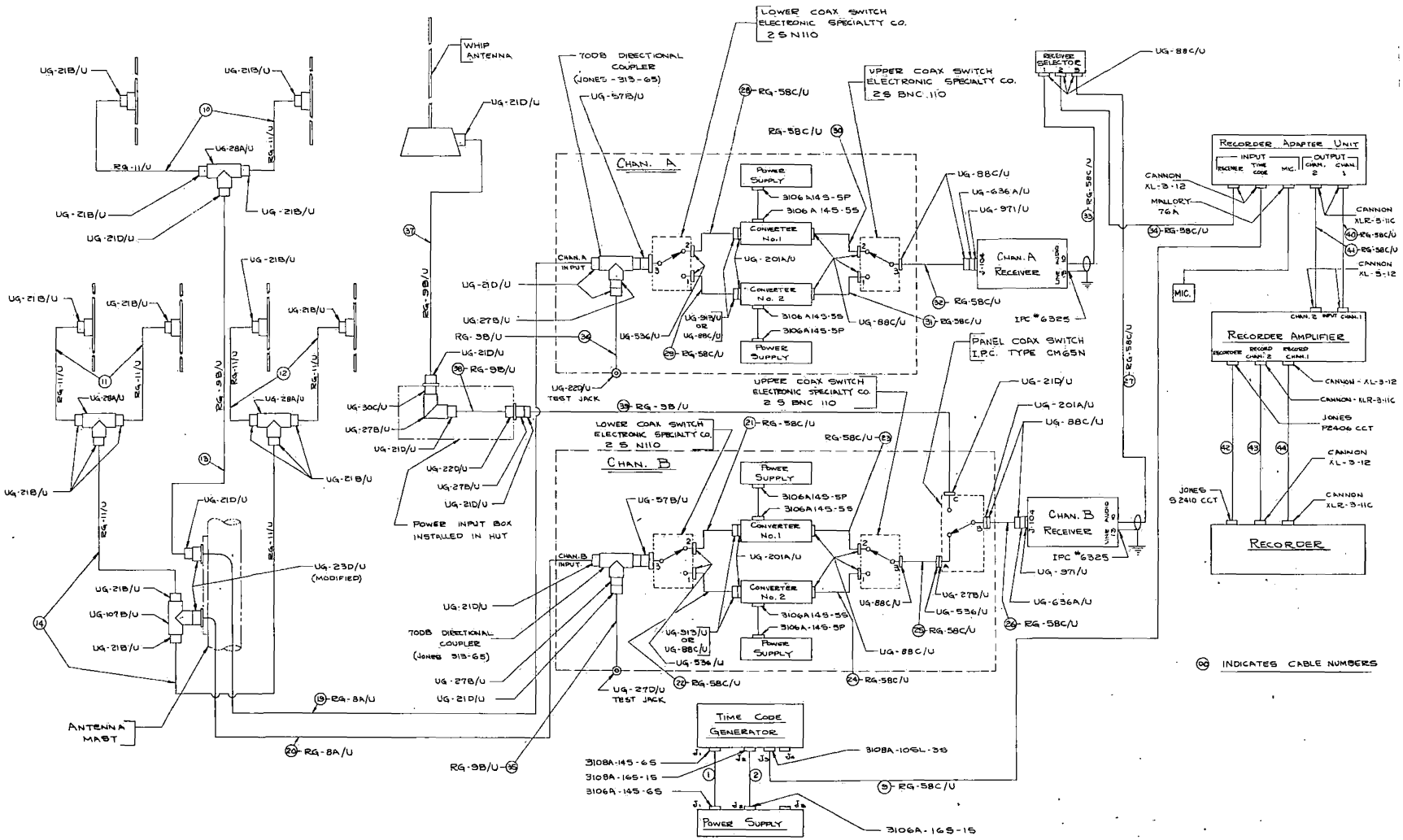

Figure 29 - Cabling Diagram

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4. Replace the rubber floor mat.

5. Secure the mounting bracket for the heater to the deck in the corner to the right of the door as you enter, using the four bolts provided with the bracket. The heater mounts into this bracket and is secured by the straps on the bracket. In this connection it should be mentioned that this heater is portable and may be removed from this mounting bracket and stood on the deck at any convenient spot where more heat might be required.

6. Secure the clock to the bulkhead above the operating table to the left of the antenna mast over the Operating Instructions. A screw has been left in place for this purpose.

8.52 Interconnecting the Units

All units are interconnected by means of flexible cables with suitable plugs at either end so that no soldered or terminal strip connections are involved. Most of the cables are marked with numbers, as are the receptacles to which they connect, in order to simplify the interconnecting process. Figure 29 is an interconnection diagram showing the manner in which the various units are connected together as well as the numbers of the various cables involved. Table 9 gives this same information in tabular form against progressive cable numbers and might be more useful for certain purposes. As a matter of general information, the various cable numbers will be found on the cables close to their end fittings.

While the electrical interconnection of the various units is relatively simple, unfortunately, the mechanical design of some of the mountings (to provide for the optimum ease of operation) is such as to require that certain of the cables be put in place in a specific order. The details of these procedures are given below. The order of these details is the order to be followed.

8.521 Time Code Generator Power Unit:

In order to reach the receptacles on this unit, it will be necessary to temporarily remove both Converter drawers from the rack and work through the opening created by their removal. Pull the power unit forward sufficiently to permit reaching the two jacks (J-1 and J-2) mounted on its rear panel at the right. These jacks are covered by protective caps secured to the chassis by chains. Cut these chains close to the chassis, remove the caps and discard them. If left in place

TABLE 9

Cables to be Connected Upon Installation

Cable No.	Connections *	How Shipped
1	Code Generator to Power Supply	In Place
2	Code Generator to Power Supply	In Place
9	Code Generator to Recorder Adapter	In Place
10**	To Two Bays of Upper Yagi Array	In Carton
11**	To Two Adjacent Bays of Lower Yagi Array	In Carton
12**	To Two Adjacent Bays of Lower Yagi Array	In Carton
13	Tee in Cable 10 to Mast Fitting (Red)	In Carton
14**	Tees in Cables 11 and 12. Center tee to Mast Fitting (Blue)	In Carton
19	Mast Fitting (Red) to Channel A Converter	In Carton
20	Mast Fitting (Blue) to Channel B Converter	In Carton
26	Channel B Converter to Channel B Receiver	In Place
27	Receiver Selector (Bulkhead) to Channel B. Receiver	In Place
32	Channel A Converter to Channel A Receiver	In Place
33	Receiver Selector to Channel A Receiver	In Place
34	Receiver Selector to Recorder Adapter	In Place
37	Whip Antenna to Hut	In Carton
40	Recorder Adapter to Recorder Amplifier (Channel 1)	In Place
41	Recorder Adapter to Recorder Amplifier (Channel 2)	In Place
42	Recorder to Recorder Amplifier	With Recorder
43	Recorder to Recorder Amplifier	With Recorder
44	Recorder to Recorder Amplifier	With Recorder

* For full installation details, see Cabling Diagram for Receiving Hut.
** Cable in two sections bearing same number and joined by a tee.

NOTE: (1) "In Place" in last column signifies cable shipped in place in hut but disconnected at one or both ends.

(2) All numbered cables are shown on Cabling Diagram including those completely connected and not listed in this Table. No cables in this installation bear number 3 to 8 or 15 to 18.

they will interfere with the free movement of the chassis. Secure the plugs on the ends of cables 1 and 2 to J-1 and J-2 respectively. Plug the power input cable (secured to the chassis) into one of the receptacles on the power conduit at the left rear of the hut near the deck, marked "Clock". Push the unit back into its rack by using the knurled knobs, and the power unit connections are complete.

8.522 Converter Units:

In connecting the Converter Units, it is suggested that Converter Unit A be placed in the middle rack compartment first and the necessary cables be connected in accordance with Figure 29. This will allow room to "fish" the various cables through the rear of the rack by working through the space eventually occupied by Converter Unit B. After all the cables (number 19, 32 and the power cable) are in place, Converter Unit A may be pushed fully into its rack compartment.

Converter Unit B may now be inserted part way into its rack compartment and its cables "fished" into this compartment and connected (numbers 20, 26, 39 and the power cable).

8.523 Receivers:

Aside from the power cable, which is permanently secured to the receiver and merely plugs into a suitable power outlet, there are but two external connections to make to the rear of the receivers; namely, the r-f input from the Converter units and the Line Output to the Receiver Selector switch box mounted on the bulkhead. However, while the r-f input jacks are relatively easy to reach, for connection of cables number 32 and 26 to jacks J104 of receivers A and B respectively, the connection to the Line Output terminals is on a screw type terminal board mounted quite low on the rear of the receiver chassis. Therefore, to make these connections, it will be necessary to remove the receivers from their racks to the Operating Table, connecting the cables (number 33 and 27) from the Receiver Selector Unit or the bulkhead after threading them through the rear of the A and B racks respectively. It will be noted that these cables at the receiver ends have spaded fittings clamped around their shielding while the inner conductors are fitted with spaded lugs. In connecting these cables to the receiver terminal boards, the shielding fittings are used as combination cable clamps and grounds and fastened under the screws of number 13 terminals on the terminal boards while the inner conductors connect to the number 10 terminals.

While the receivers are out of their racks, one final action is necessary; namely, the removal of the upper and lower dust shields which are secured by a number of Binder Head screws around the sides of the chassis.

After the connections have been made to both receivers and their dust shields removed, they may be slid back into their racks.

8.524 Recorder, Recorder Amplifier and Recorder Adapter Units:

The Recorder Adapter is part of the mounting rack and is shipped with all the cables connecting to it in place with the exception of the Microphone cable that plugs into the receptacle marked "MIC". The two output cables (Channel 1 and Channel 2) plug into similarly marked receptacles on the Recorder Amplifier Unit, while cable number 9 connects to the TIME CODE receptacle. Cable 34 from the number 2 terminal of the Receiver Selector Unit plugs into the receptacle marked RECEIVER. The Recorder has three cables attached to it which, during installation, are carried down and plugged into the three receptacles on the Recorder Amplifier marked RECORDER and RECORDER CHAN 1 and CHAN 2 respectively. These three cables all carry different types of plugs and will only mate with the proper receptacles.

Caution: In no case should the output of the Time Code Generator ever be plugged directly into either the Channel 1 or 2 input receptacles of the Recorder Amplifier as such action could cause a burn-out in this unit.

8.525 Time Code Generator:

This unit has but three receptacles on the rear of its chassis. The right hand and middle receptacles (facing the rear of the unit) receive cables number 1 and 2 respectively while the left hand terminal receives cable 9 from the Recorder Adapter Unit. These can all be readily connected from the top of the Generator Unit.

8.53 Securing Units into Racks

After all the various units have had their cables connected and are back in their racks, they should be secured by the 10/32 binder head machine screws provided for this purpose. A sufficient number of these screws with spares will be found in a small bag attached to the Channel A receiver rack. It will be noted that a number of these screws are somewhat longer than the majority. These should be separated and used in securing the Recorder Amplifier to its rack, the Recorder Amplifier panel being somewhat thicker than the other units. It is also suggested

that it might be desirable to put power on the system for a preliminary check-out before finally securing the units to their racks.

8.54 Connection of Units to Power Circuits

Figure 6 shows the method by which the power circuits are carried around the interior of the hut. The various circuits are carried in square metal conduits with numerous outlet receptacles provided for plugging-in the different units. It will be noted that the two 120-volt sides of the 240-volt, three-wire system, are carried around opposite sides of the hut near the overhead and part way around the end over the Operating Table and down toward the Table. There is an additional run of conduit carried on the left side of the hut near the deck marked "Clock Circuit". This feeds from a separate switch on the power panel, ahead of the Main Line switch, so that power may be removed from all the equipment in the hut by the Main Line switch without de-energizing this circuit. A 240-volt circuit is carried down the right bulkhead and half way around the end near the deck, with a thermostat interposed between its switch and the conduit run. This is for connection of the Heater. In plugging-in the various units, use the circuit run on the left for those units on the left and the circuit run on the right for those units on the right (with the exception of the Time Code Generator Power Unit and Clock). This will reduce the load carried by the neutral wire. The Time Code Generator and Clock should plug into the "Clock" circuit in order to permit keeping these units active at all times, even with the Main Line switch thrown OFF.

8.55 Power Feeder

The power cable for feeding power to the hut plugs into a watertight receptacle mounted in a recess on the exterior of the hut to the left of the door. Sufficient length of this cable has been provided for each installation to permit connecting to the primary source of power available. This cable is of the " Tyrex " type designed and suitable for plowing-in or otherwise burying in the ground without any conduit or duct protection. It is accordingly recommended that wherever possible this cable be buried at least several inches under ground, for its own protection.

8.56 Grounding of the Hut

It is essential that the hut be thoroughly grounded. A terminal with a wing nut is provided on the recessed section adjacent to the Power Input receptacle for connection of a ground wire. It is suggested that a ground rod or pipe be driven at least several feet into the ground below this ground terminal and connected to it

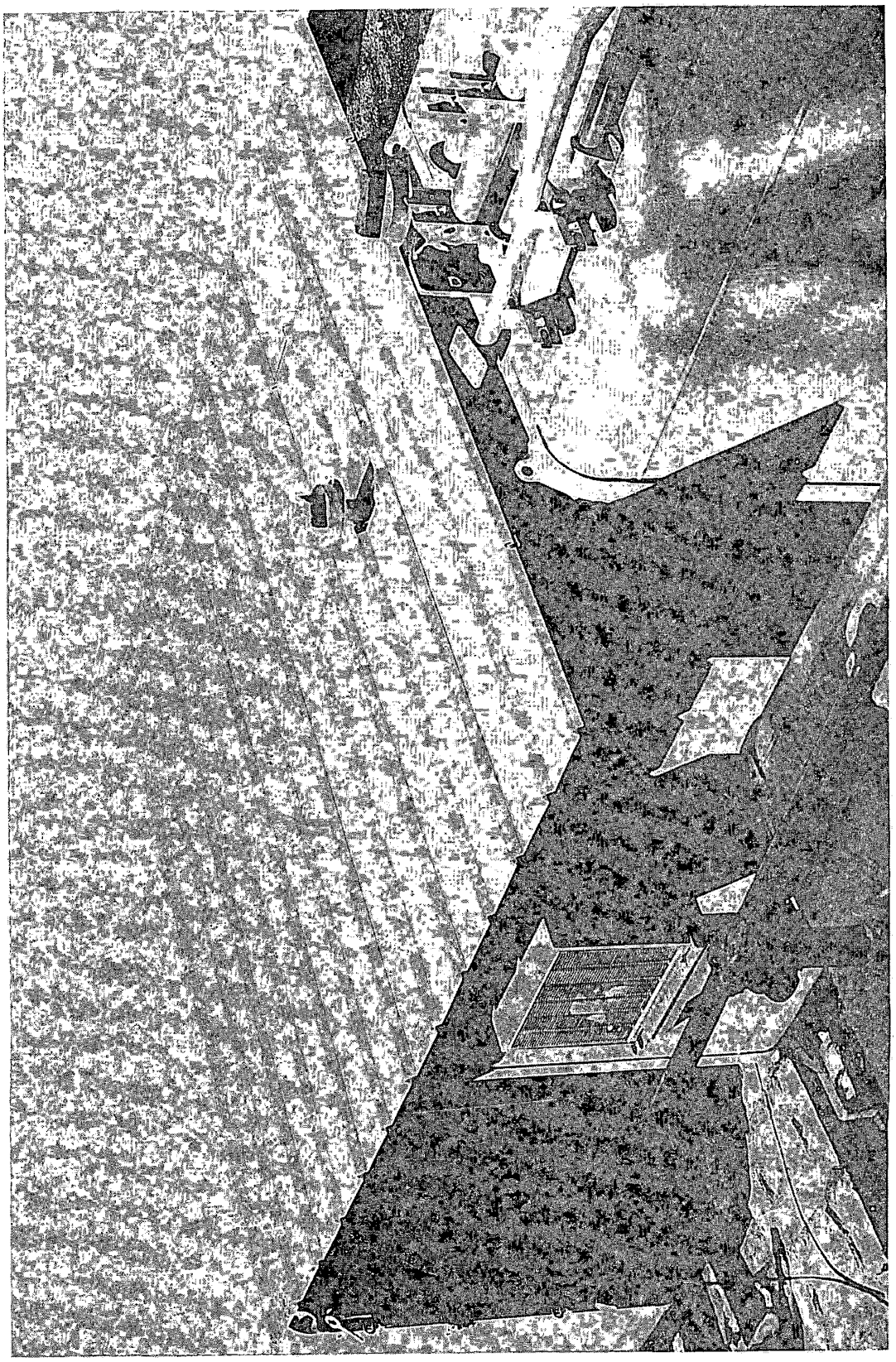

Figure 30 - Overhead View of Sun Canopy

by as short a length of heavy wire as possible. No ground rod or wire are furnished with the shipment as the details of this feature will undoubtedly vary from installation to installation. However, do not attempt to use the whip antenna counterpoise as a ground medium for the hut.

8.6 INSTALLATION OF SUN CANOPY ON TROPICALIZED HUT

8.61 General Description

The sun canopy consists of an additional bright aluminum roof mounted approximately eight inches above the roof of the hut (to permit air circulation between them) and extending approximately three feet beyond the sides of the hut to give some shade to these surfaces. It is supported by a framework of two-inch aluminum angles 1/4 inch thick which, in turn, is supported by four risers bolted to the sides of the hut.

The roof material is .051 inch hard aluminum sheet except for one section designed to support the weight of a man who might have to work on the antenna, where the thickness is increased to .093 inch.

The roof proper is sectionalized to permit of ready shipment and is easily bolted in place on assembly. All securing holes are pre-drilled and tapped so that no machine work is required. The various sections are stiffened by rolled-in ribs.

Figure 30 shows the appearance of the sun canopy as installed on a hut and as viewed from above.

8.62 Definition of Terms

To preclude any misunderstanding of the assembly details that follow, the following terms shall apply:

FORWARD - The door end of the hut.
AFT - The mast end of the hut.
LEFT - With respect to facing the mast from the door end of hut.

8.63 Markings

All sections of the framing and the roof have been given designations both as to their assembled position and their mating members and are clearly marked with red lacquer. For example, the vertical risers that secure the top framing to the hut are marked UPRIGHTS and their ends marked with designations such as 2A, etc. which secure to other members with the same markings. Figure 31 should clarify this detail.

8.64 Pre-Installation Preparations

As indicated by its designation, the Sun Canopy is intended only as a sun shade and is not, nor was it designed to be a load bearing device, which is to say that it is not suitable for standing or walking on (with the exception of one small section designed to permit antenna maintenance and described below). On the other hand, the erection of the antennas requires several men with free movement around the roof of the Hut.

Therefore, BEFORE ANY WORK IS DONE ON THE INSTALLATION OF THE SUN CANOPY, BE SURE THAT THE ANTENNAS ARE COMPLETELY ERECTED, ALL CABLING WORK FINISHED AND THE JIB POLE REMOVED.

Parenthetically, in the Figures showing the canopy in place, the antenna structure was purposely omitted to give a clearer view of the appearance of the canopy and the assembly markings.

8.65 Assembling the Frame

The horizontal frame for the canopy is supported by four 2 x 2 x 1/4 inch aluminum angle members bolted to the sides of the Hut near the ends. These are approximately 33 inches in length and may be further identified by the words UPRIGHT painted on them. The sides of the Hut near where they are to be secured are marked 1A, 2A, 1B and 2B and the ends of the UPRIGHTS are similarly marked. On one of the UPRIGHTS will be found a bag containing

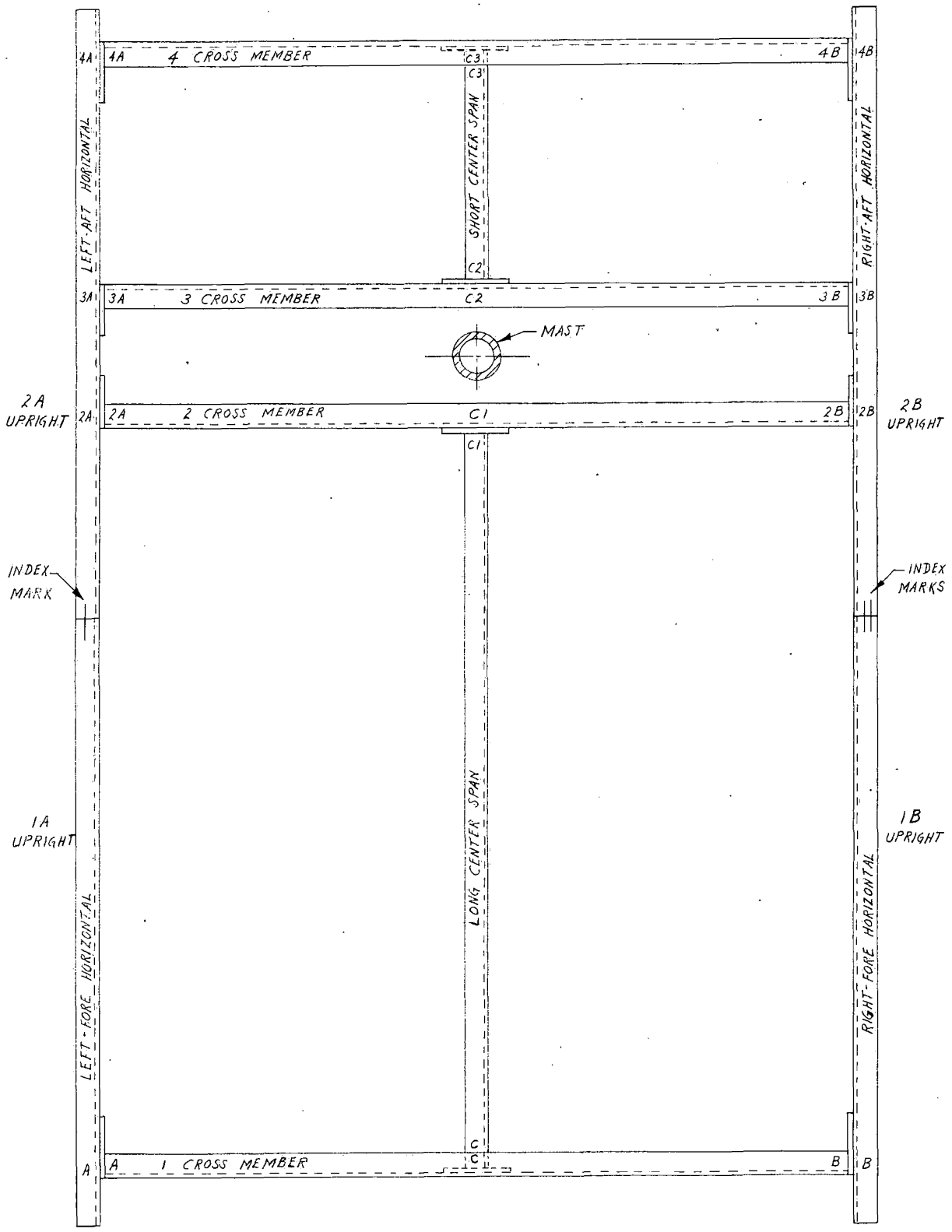

Figure 31 - Assembly Plan of Sun Canopy Framing

12 hex. head bolts, 5/16-18 x 1 inch long. Match the markings on the UPRIGHTS with those on the Hut and bolt them in place in a vertical position with these bolts. Pull the bolts up securely but not so tight as to preclude moving their upper sections enough to line up with the holes in the horizontal framing.

Now assemble the two outboard horizontal frames. These are made up of four angle members, each approximately six feet long and must be assembled to form two members 12 feet 3 inches in length. Pick the members marked LEFT-FORE HORIZONTAL and LEFT-AFT HORIZONTAL and join them together with the splice plate already secured to one of them, using the bolts already in the holes of the other. The index marks on the two sections should mate.

Repeat this same procedure with the two members marked RIGHT-FORE HORIZONTAL and RIGHT-AFT HORIZONTAL.

Now lift these two 12-foot 3-inch members to the roof of the Hut and securely bolt them to the four UPRIGHTS, being sure that the left and right members are on the proper sides of the hut and both AFT sections face aft, i.e. toward the mast.

Now pick out the four cross members. They are all marked CROSS MEMBER preceded by a number (1, 2, 3 and 4). Bolt these to the two horizontal members, matching number designations marked on their ends with similar numbers on the horizontal members. #1 goes over the door end of the Hut, #2 and #3 next progressively and #4 over the mast end.

Next bolt the two remaining angle members marked SHORT CENTER SPAN and LONG CENTER SPAN in place.

Figure 31 will show clearly the proper position of all the various members when properly assembled.

If the assembly is satisfactory, tighten all bolts securely, including the twelve holding the four UPRIGHTS to the hut.

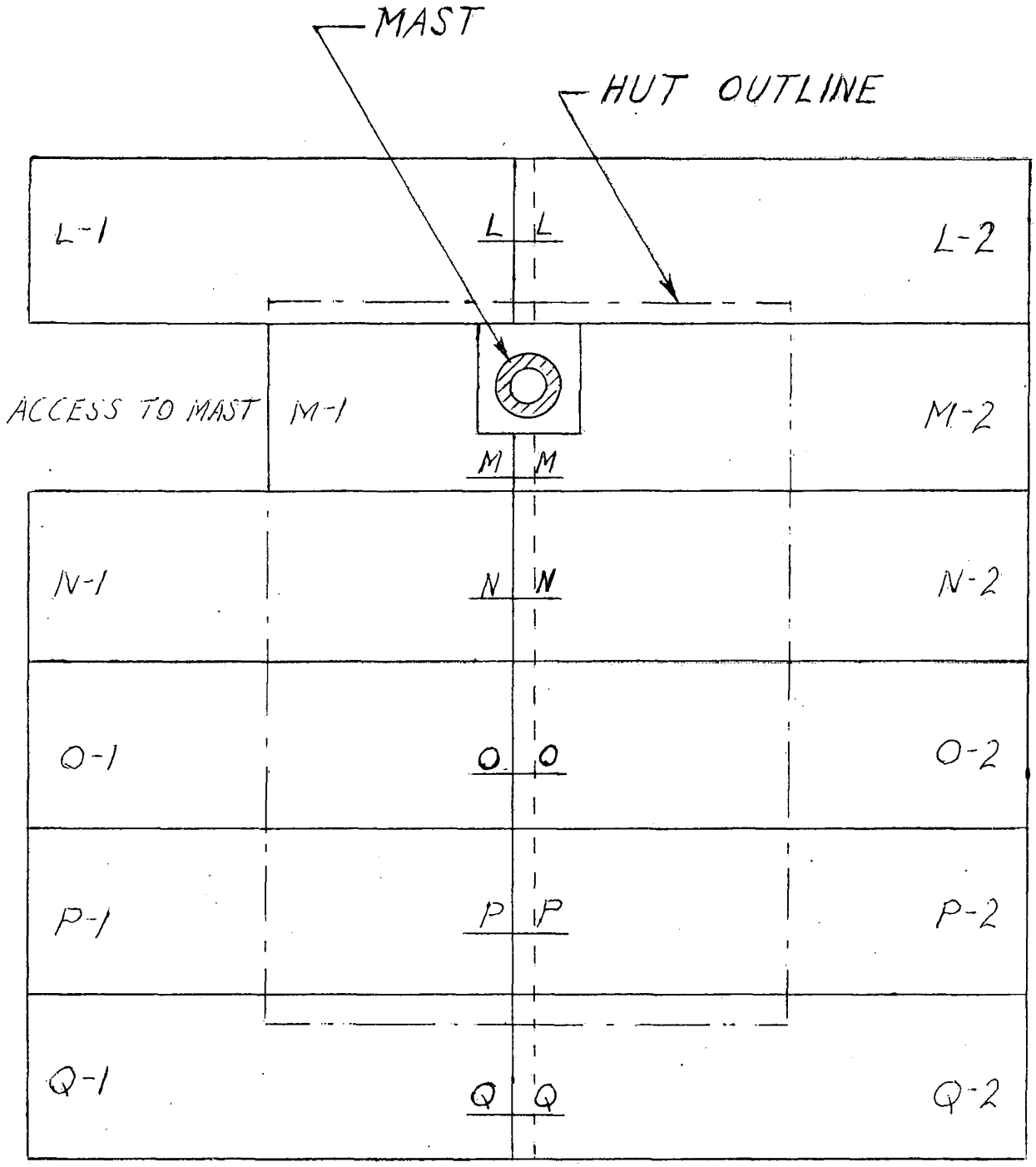

Figure 32 - Assembly Plan of Sun Canopy

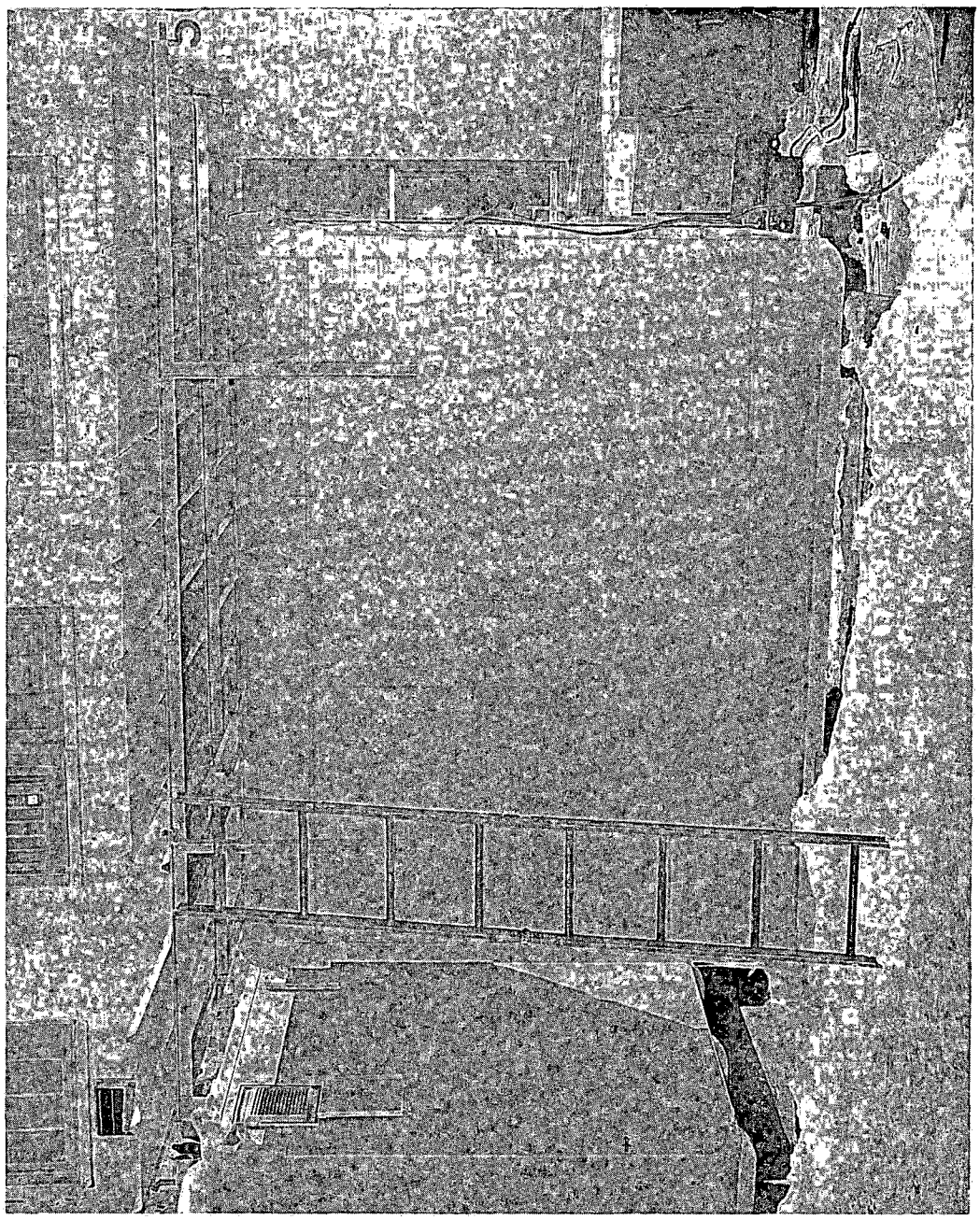

Figure 33 - Side View of Sun Canopy
Showing Access

8.66 Assembling the Canopy Roof

The canopy roof consists of twelve ribbed aluminum panels. Study Fig. 32 and note the letter and number designation on each panel. Figure 5 shows the roof completely assembled. Start canopy assembly with panel marked "L-1". Set this panel in place on the left aft end of framework. Set the panel marked L-2 on the right aft end of framework. Bolt these two panel sections to the framework. The panel sections are drilled and the framework members are already tapped for bolts. The necessary 1/4-20 x 1/2-inch long hex head bolts are in a bag tied to one of the panel sections. Now lay in panel marked M-1 followed by panel marked M-2 and again bolt the panel sections to the framework. Repeat this procedure for the remaining eight panels, assembling two panels at a time. The last two panels Q-1 and Q-2 can be bolted to framework by standing on a step ladder. The cutout in panel M-1 will permit a man using a ladder to climb on to the canopy and walk to the mast over panel M-1 (See Figure 33). The 2 x 2 x 1/4 angle framing members under panel M-1 will support the weight of a man although it will have a springy feel. Do not walk on any other section of the canopy after setting it in place on the framework.

8.7 INSTALLATION OF AIR CONDITIONER ON TROPICALIZED HUT

On the right wall of the hut near its center, at shoulder height, will be found an opening 18 inches by 22 inches for the installation of the air conditioner. Along the roof line above the opening is installed a small rain run-off trough. A length of wood 2 x 4 is fastened to the outside wall of hut immediately below this rain trough to protect it from damage during shipment. Remove the machine screw from each end of the 2 x 4, lift and discard. The air conditioner opening on the outside of the hut is covered with an aluminum plate for weatherproofing the hut during shipment. Remove the tape from around the outside edge of this plate. From inside the hut, remove four nuts at the plate corners and remove corner clips. Lift off the plate and discard.

The one-piece welded aluminum air conditioner mounting frame can be easily identified by referring to Figure 5 showing the complete air conditioner installation. Bolt this mounting frame to the side of the hut below the opening so that the tapped holes in the side of the hut line up with the corresponding drilled holes in the mounting frame. The necessary 5/16-18 x 1-inch-

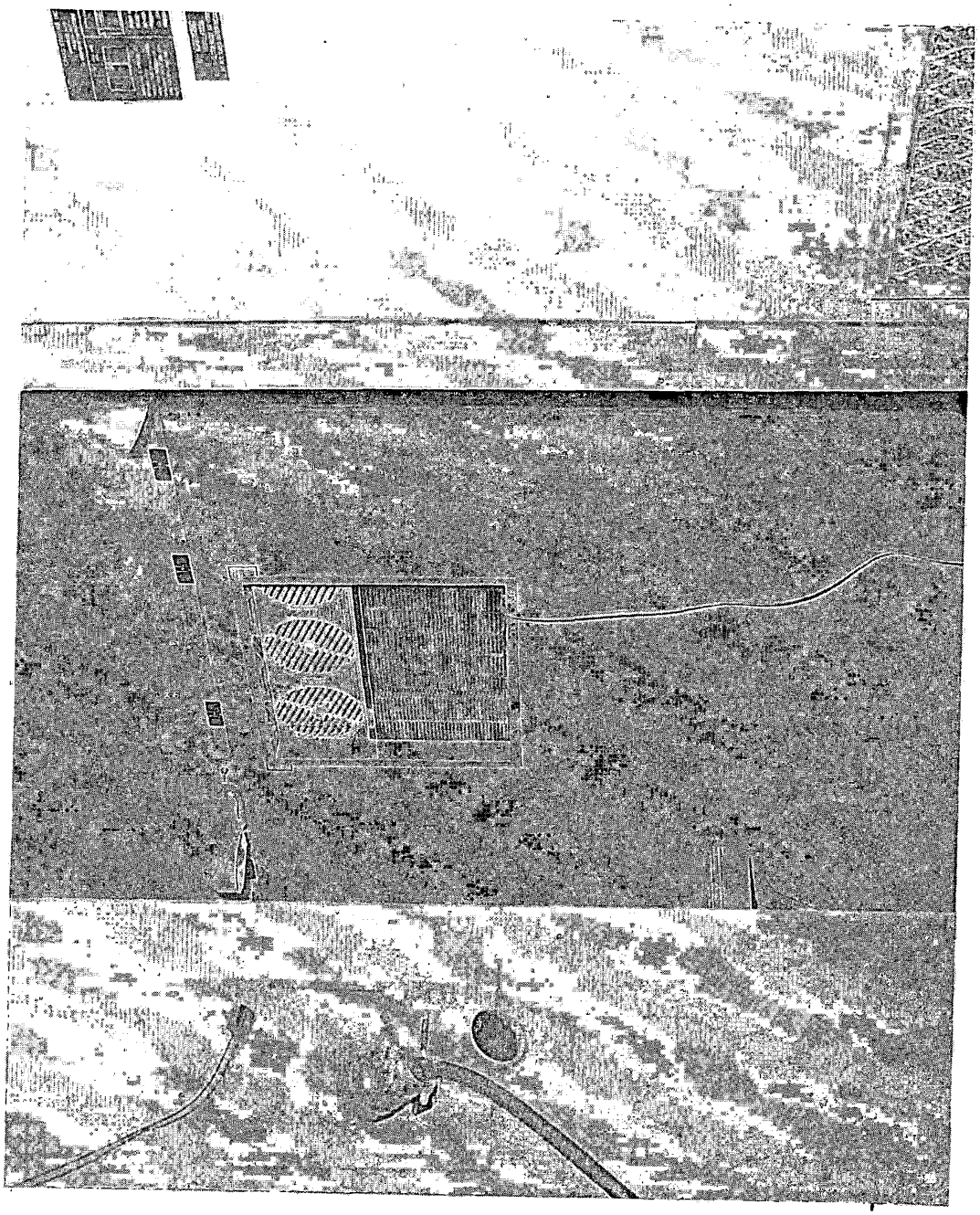

Figure 34 - Interior of Hut Showing Air Conditioner

long hex head bolts are in a bag tied to the frame. Unbolt the 1 x 1 aluminum angle running along the back edge of top plate of the mounting frame, retaining it and its bolts.

Take the roll of PERMA-TITE sponge rubber weatherstripping furnished with the equipment and, following application instructions on its box, cut four lengths, running a continuous band of rubber weatherstripping around the outside edge of the opening over the painted white indicator line. Repeat this operation with a second layer of stripping to give a seal or gasket 1 inch width by 5/8 inch in height. The adhesive on back of the rubber weatherstripping should be adequate for purposes of this installation, no additional adhesives are required.

Remove air conditioner from packing crate and remove its wooden base. Lay the conditioner on one side and screw in the four slotted-head screws on the bottom. These screws hold the compresser rigidly in place during shipping and must be screwed into the conditioner before starting up the machine. Turn the air conditioner right side up again. Remove the lower right hand grille panel from the face of the air conditioner. Reach through the opening and pull out the electric cable and plug. Replace the grille panel on the face of air conditioner. Lay electric cable on top of air conditioner and temporarily tape in place. Lift the air conditioner on to the top plate of welded mounting base. Place the electric cable through the opening in hut wall, as shown in Figure 34 . Push air conditioner tight against the rubber seal. Replace the 1 x 1 aluminum angle along the back of the air conditioner and bolt tightly in place. Plug the cable into the power receptacle near the deck.

Note: To the left of the door of the hut as you enter, is a toggle switch marked "THERMOSTAT - ON - OFF". To operate the air conditioner this switch must be in the OFF position. To operate the heater unit this switch must be in the ON position.

SECTION 9

POST-INSTALLATION CHECK-OUT

9.1 THE POWER CIRCUITS

After the installation has been completed in all detail, before the power line is plugged into the hut, it would be a wise precaution to disconnect all equipments from the power receptacles into which they might be plugged to protect them in the event an error might have been made in the connections to the three-wire feed system at either end of the line that would put 240 volts on any of the 120-volt distribution circuits. After the various units have been cleared from their circuits, apply power to the hut and turn on all the lights. If they all light but don't burn out or show over brilliance, the power connections are correct. Of course, a check with an ac voltmeter is more reliable.

Replace all the power plugs from the various units into their proper receptacles and turn on all units. Assure that they are all "up" as indicated by their pilot lights. Turn on both fans and the heater (temporarily if they are not needed) in order to place full load on the power circuit. If it is too warm for the heater to come on at its thermostat setting, push the thermostat up until it does.

Measure the voltage on both 120-volt circuits. If either is below 105 or above 130, you are on the border line of malfunctioning or damage to some of your equipments. If the full load voltage is within limits, turn off the heater and remeasure the voltage to assure that it does not rise above 130, indicating poor regulation.

After assuring that the power circuits are satisfactory, proceed to check the various electronic units individually, after they have had at least an hour warm-up period.

9.2 THE TIME CODE GENERATOR

First check the dc voltage from the power unit with the generator operating. Plug a high-resistance dc voltmeter between the red pin jack TJ1 and ground.

TJ1 is on the top of the chassis near the rear and to the right of center and it will be necessary to slide the Generator chassis part way from its rack to reach it. THE VOLTAGE SHOULD READ EXACTLY 200. If it is high or low, adjust it by means of potentiometer R7. R7 is in the power unit directly behind the panel at the extreme upper right hand corner and may be reached by sliding the power unit several inches from its rack.

Next check the time-indicating neon lights to assure that they are all operating. Operation of the second-indicating lights can be readily determined by merely watching them for a minute or so to assure that they all light progressively. Then check the minute-indicating lights. To do this, hold in the push button on the front of the panel marked "Minute Set" which permits the Generator to run through the minute progression at one second intervals. Finally, check the hour-indicating light in a similar manner, this time by holding in the "Hour Set" push button. Carry this check sufficiently far to assure that the hour indications turn over at 24, as one of the evidences of malfunctioning of this device is its failure to make this turn over and indicate 25 or 26 hours etc. The process of checking the minute and hour indicating lights may be speeded up somewhat by holding in the "Advance" button at the same time you hold in the "Set" buttons. This makes the lights change at 0.5 second instead of 1.0 second intervals.

If all the time-indicating lights show satisfactory operation, it indicates that the Generator is operating correctly, although it is not a check of its accuracy. This should be checked later after the Generator is set to correct time from a suitable time signal.

It furthermore does not check the output system that feeds the Recorder. The best simple check for this is an acoustical one. Turn the Channel 1 gain control on the Recorder Amplifier sufficiently to obtain a reading of 0 VU on the first meter (with the Master Gain control full on to 18). Turn the Loud Speaker Gain to Channel 1 until you hear the Time Code Generator output. If it is operating satisfactorily, you should hear a 1,000-cycle note in the background with a harsh 100-cycle note over it, and the presence of increases or

"kicks" of this note at one-second intervals which will show up on the VU meter as approximately 1 VU increases in reading. Should you have a sample recording of the generator output, use this as a comparison.

As a final check, assure that the output level from the Generator is correct. It is essential that this level be so set as to match the voice level from the hand microphone as viewed by the Recorder. When the push-to-talk button is depressed, the Generator output is disconnected from the Recorder Amplifier and the microphone output substituted. To check the Generator output level adjustment, depress the push-to-talk button and do some test counting into the microphone, (such as 1, 2, 3, 4 etc.) at a distance of three to four inches, varying the Channel 1 gain of the Recorder Amplifier until the #1 VU meter gives an average reading between -3 and 0 VU. Then release the button and observe the indicated level from the Generator at this gain setting. Should it read appreciably greater or less than -3 to 0 VU, readjust the gain control on the Generator panel with a screw driver until a -3 VU reading is obtained.

9.3 THE RECEIVING SYSTEMS

Both receiving systems are identical except for their antennas and converter frequencies; therefore, they may both be checked by the same procedure. Accordingly, this procedure will only be delineated for the Channel A system, it being understood that the Channel B system should be checked in exactly the same manner.

9.31 Checking Channel A Receiving System

Assuming that the equipment has been warmed up for at least one hour, (longer would be better) proceed as follows:

1. Set the panel controls of the R-390A/URR receiver as follows:

   LIMITER, BREAK IN & BFO - Off
   FUNCTION SWITCH - MGC
   AGC - Fast
   AUDIO RESPONSE - Wide
   LINE METER - 0

LINE GAIN - 6
BAND WIDTH - 8 kc
RF GAIN - 0
LOCAL GAIN - 5
MEGACYCLE & KILOCYCLE CHANGE - To your assigned frequency

2. Advance the RF GAIN control until an appreciable noise level is heard in the headphones.

3. Advance the LINE GAIN control until the LINE LEVEL meter reads about half scale.

4. Adjust the ANT. TRIM. for maximum reading of LINE LEVEL meter (being sure there is no signal other than noise being received). Should the meter go off scale, retard the LINE GAIN and retrim.

5. Now slowly advance the RF GAIN control toward 10, watching the LINE LEVEL meter carefully. As it approaches going off scale, keep reducing the LINE GAIN, keeping as high an on-scale reading as possible. Continue this procedure until you reach a point on the RF GAIN setting where a further advance causes no further increase or a reduction in the LINE LEVEL meter reading. This is the gain setting that permits the noise generated in the antenna and converter input tube, as well as that received from the sun, etc. to saturate the fourth i-f tube of the receiver and indicates that the entire receiving system possesses an excess of useable gain, which is all that can be expected of it.

6. To check the antenna, if the installation is in a quiet location, rotate the antenna through 360 degrees while watching the LINE LEVEL meter. The noise at certain times of the day or night should show a variation of one or more db as the direction of the antenna is changed, indicating that the antenna is operating satisfactorily.

7. Switch Channel A converters. The variation in output noise between the two converters should not exceed 5 VU. This indicates that the Channel A Converters are satisfactory as to sensitivity.

8. Finally, if a Signal Generator is available, check the frequency match between the oscillator crystals in the two sets of converters. To do this make the following tests on each channel independently. Turn on the BFO and with the R-390A/URR receiver set on the assigned frequency inject a signal from the Signal Generator into the test jack at an approximate 45 dbm level, adjusting the frequency until a beat note is heard. Vary the BFO PITCH control until you get zero beat. Then switch Converters. You should now get an audible signal. Readjust the KILOCYCLE CHANGE (tuning) control until you again get zero beat. The difference in the two frequency readings is the frequency difference between the crystal oscillators in the two converters and the sign of the retuned frequency will indicate whether the second Converter frequency is high or low. Higher receiver means lower crystal frequency.

9.32 Checking Channel B Receiving System

The VHF operation of the Channel B system should be checked in exactly the same manner as the Channel A system. However, should it be noted that the Channel B system appears to show greater sensitivity as indicated by a lower r-f Gain setting for the same noise output as Channel A; this is an illusion. In certain of the Channel A receivers, gain of the third i-f stage has been reduced (by an internal control) to preclude their too-ready saturation and to compensate for the increase in over-all system gain resulting from the additional gain of the Converters. This desirable adjustment could not be made on the Channel B receivers because their full gain capabilities are required for the reception of Time or other HF signals where the Converters are not used.

9.33 Measurement of Receiving System Sensitivity

Should there be a reliable Signal Generator available that covers the two frequencies with which you are concerned, you may make a quantitative check of the sensitivity of your two receiving systems, except for the antennas. Proceed as follows; first for Channel A and then for Channel B.

1. Disconnect both antennas (Cables No. 19 and 20) from your converter units at the Directional Coupler.

2. Connect the output of the Signal Generator to the coax receptacle marked "test" on the front of the Converter unit drawers.

3. Set all receiver controls as shown in paragraph 9.31.1 above.

4. Set the modulation of the Signal Generator at exactly 30% at 400 cycles.

5. Set the frequency of the Signal Generator to the frequency involved, with the output to approximately 50 dbm.

6. Now set the LINE METER to -10 and the LINE GAIN to 10.

7. Slowly advance the RF GAIN until the LINE LEVEL meter reads.

8. Adjust the Signal Generator tuning until the meter reads maximum, changing the RF GAIN as necessary to keep the meter on scale.

9. Reduce the Signal Generator output to as low a value as possible (maximum dbm).

10. Carefully adjust the RF GAIN until the LINE LEVEL meter reads 0 VU. This is the reference noise level.

11. Change the LINE METER switch to 0.

12. Increase the output of the Signal Generator until the meter again reads 0 VU, or 10 db above the noise level.

13. The output reading of the Signal Generator plus 70 db is the sensitivity of the receiving system for an 8 kc band width for a 3.1:1 (10 db) signal/noise ratio. The 70 db is the attenuation of the "directional coupler" between the Signal Generator and the Converter input and must be added to the Generator reading to obtain the real value of the voltage being impressed on the Converter.

14. Be sure to replace the antenna cables after completing the measurements.

UNDER THE ABOVE CONDITIONS OF MEASUREMENT, THE SENSITIVITY OF EITHER CHANNEL SHOULD BE NOT LESS THAN -120 DBM.

9.34 Some Notes on Sensitivity Measurements

There is often misunderstanding or confusion in the minds of many as to the significance, accuracy and utility of receiver Sensitivity measurements. In an attempt to alleviate this, the following brief comments are offered.

9.341 The Significance

The measurement of the Sensitivity of a receiver made as described in paragraph 9.33 above is not the measurement of the effectiveness of a complete receiving system and in no way is a figure of the field density of a signal at an antenna required to effect reception. It merely indicates that a certain number of microvolts of signal, modulated a certain percentage, will, when impressed on the receiver input, produce an output a certain number of db's above the noise output. A change in the usable signal/noise ratio (which depends on the service required), or a change in the modulation percentage (which depends on the nature of the desired signals) or a change in the noise, will change the figure. This latter factor of variations in noise is of most importance because the measurement is one of a signal/noise ratio and, when an antenna is attached to a receiver, the noise level will increase as a result of the thermal noise the antenna introduces and the reception of both local, atmospheric and cosmic noises.

9.342 The Accuracy

The Sensitivity of a receiver, while often expressed in terms of db or dbm is, in reality, a voltage ratio measurement. Accordingly, a measurement of -124 dbm to an accuracy of 1 db predicates a measurement accuracy of one part in 1.4 million. This is considerable accuracy for measurements made in a laboratory, using primary standards. Field instruments are not designed for any such order of accuracy nor can it be expected that they will maintain the accuracy they possess when in field use. Furthermore, there are too many sources of possible error to compound themselves. The percentage modulation and reference level indications may not be accurate; a not uncommon failing, the range overlap of the output meter may be faulty, the output attenuator may not be accurate throughout its range or the output frequency of the Generator may drift during measurements, a very common failing at the frequencies in question. And finally, there are meter reading errors resulting from parallax and the averaging of noise "wobbulations". Therefore, should your measurement

figures differ from those expected by several db, don't be alarmed. The acid test is whether or not you can repeat the figures you obtain with an accuracy of 1 db or better and whether both channels show relatively the same figure of Sensitivity.

9.343 The Utility

The most important use of quantitative Sensitivity measurements is to permit the determination of the maintenance of the sensitivity of the equipment with time and use. If the equipment appears to operate satisfactorily as first installed, the actual Sensitivity figure you measure at that time is, if not too far off, of less importance than the figure you get from periodic measurements during operation, provided they are made under the same conditions. This is to say that, while absolute Sensitivity figures are often of importance to laboratories in the comparison of different equipments, your prime concern is in the assurance that, whatever the Sensitivity figure you first measure might be, the equipments hold it throughout their life in your service.

9.4 THE RECORDER AMPLIFIER

The only characteristic that can be readily checked on the Recorder Amplifier and the one of most importance is that of the relative gain of the two amplifier channels. To accomplish this, proceed as follows:

1. Remove the Time Code Generator plug from the Recorder Adapter Unit (second plug from the left facing the rear of the rack).

2. Advance the Master Gain Control full on, (to 18).

3. Be sure there is no signal or noise from either receiver.

4. Hold in the CALIBRATE button on the Amplifier.

5. Advance the two individual Channel Gain controls, one at a time until both VU meters read 0 VU, first assuring that they read 0 when against the counterclockwise stops.

6. Note the settings of the two Gain Controls.

7. IF THEY BOTH READ LESS THAN 9, BOTH AMPLIFIERS ARE OK. If either reads less than 9, the amplifier for that channel is low in gain.

8. Replace the Time Code Generator Plug in its receptacle on the Recorder Adapter Unit.

9.5 THE RECORDER

9.51 Test of General Performance

Inasmuch as the first and primary function of the Recorder is to record and play back, the best and most readily made check is with respect to these characteristics. Proceed as follows:

1. After a roll of tape has been properly threaded in the machine, check your "Record" and "Rewind" controls to assure that both motors are operating satisfactorily.

2. Acquire a signal on the whip antenna and the Channel B receiver and make a recording of it for three to five minutes at a level between -3 and 0 VU. If no signals are obtainable, make a voice recording using the hand microphone.

3. Rewind and play this recording (on Channel 2) back. If it sounds satisfactory:

4. Rewind and play back Channel 1 (the Time Code Generator channel). You should hear a rough 100-cycle note with a weaker 1000-cycle note in the background and one second "pips".

5. Rewind again, close both amplifier gain controls and run the same amount of tape you recorded on, in the "record" position.

6. Rewind once more and then play back with both channel Gain controls and the Master control wide open. Throw the speaker from one channel to the other and listen intently for any evidence of a play back of the signals you first recorded or of the Time Code Generator signals. This will check the satisfactory operation of the bias oscillator and the erasing head, as indicated by the absence of any signal.

9.52 Test for Flutter and Wow

For certain applications, a low degree of flutter and wow in a recording system is of considerable importance. Unfortunately, the measurement of these characteristics is not only extremely difficult to make but requires much special laboratory equipment. Should your recorder be suspected or you be advised that it does possess these deleterious characteristics to a detrimental degree, the only practical action is to make a sample recording of a 3,000-cycle note on a full roll of tape and forward it to Washington for analysis and recommendations.

The most satisfactory and simple way of making this recording is to use the crystal Calibrator and BFO in your Channel B receiver. Tune the receiver to any arbitrary frequency that will produce beats with your Calibrator, setting the tuning preferably on some even frequency. Adjust the BFO carefully for zero beat. Then change your tuning exactly 3 kc. This will give you an output frequency of acceptable wave form within a relatively few cycles of 3,000. Use this for your recording at a level between -3 and 0 VU.

SECTION 10

POST - INSTALLATION ADJUSTMENTS

- 0 -

10.1 GENERAL

All the equipments have been thoroughly tested and all units properly adjusted (insofar as possible) prior to shipment and should the Post-Installation Check-outs indicate that no derangements have occurred during shipment there should be little necessity for any adjustments of any of the units.

However, should these Check-outs indicate that any of the units have been adversely affected by shipment, suitable readjustments should be made in accordance with the Instruction Manual covering the particular unit or units involved. These Manuals are in the hands of the activities involved and contain all the necessary instructions in considerable detail.

The one unit that obviously will require adjustment is the setting of the Time Code Generator to correct time. This should be done in accordance with the instructions in its Instruction Manual.

The one adjustment that will most likely also be necessary and one of considerable importance, is the adjustment of the Kilocycle Change (tuning) dials on both R-390A/URR receivers for exact frequency accuracy at the particular operating frequency assigned to each installation. These dials can be adjusted against the Calibrating crystal included in each receiver to any frequency in 100-kc increments. Inasmuch as the indications on the tuning dials are not exactly linear over their range, the dials should be set at the crystal harmonic frequency closest to the assigned frequency. The process is described in the Instruction Manual but briefly it is accomplished by setting the dial to this closest 100-kc frequency, declutching the dial by turning the LOCK (on the right below the dial) hard clockwise, adjusting the KILOCYCLE CHANGE knob (the dial should not move) until an exact zero beat is obtained with the FUNCTION switch in the CAL position and then reclutching the dial by turning the LOCK counterclockwise.

10.2 ADJUSTING CONVERTER OSCILLATOR FREQUENCIES

In all superheterodyne receiving systems the Intermediate Frequency is either the sum or difference of the oscillator and the received frequency. In this system the difference frequency is used, the second harmonic of the crystal frequency, which is lower than the received frequencies in both sets of Converters being used. The Intermediate Frequency is the frequency to which the R-390A/URR receiver is set, as indicated by its counter-type dial.

In designing these equipments, the respective crystal frequencies were so chosen as to theoretically produce the same Intermediate Frequency for both Channels (even though the incoming frequencies are different) as well as the same i-f frequency from both #1 and #2 Converter in each set. Practically, however, it is impossible to obtain and maintain this perfection. Aside from the fact that crystals can only be economically ground to certain tolerances (in this case .005%), changes in temperature and heater voltages (which are not controlled) as well as mechanical changes in the circuit shielding resulting from case strains, affect the frequency.

Accordingly, while all the crystals were adjusted, prior to shipment of the equipments so that the desired i-f frequencies were obtained within an accuracy of 200 cycles or better, there is no assurance that this accuracy has been maintained during shipment nor that it will be maintained during the operating life of the equipments. Because of the extreme difficulty of adjusting the frequency of the respective oscillator crystal circuits, it is not only hoped that they have maintained their original adjustments, but it is recommended that no effort be made to readjust the frequencies as long as they have not drifted to an unusable degree, such as in excess of 2,000 cycles. Advise Washington before making an attempt at readjustment.

There are two prime difficulties involved in attempting to adjust the crystal circuits to exact frequency. The first is that it necessitates a standard oscillator with an accuracy and stability in excess of one part in ten million, equipment seldom found outside a well equipped laboratory. Signal Generators are useless for this purpose. The second revolves around the fact that the crystal circuits cannot be accurately adjusted with the units

removed from their cabinets because the strain and distortion of the cases when the units are replaced and clamped into their drawers will change the adjustment to a prohibitive degree.

Because of these factors, it is recommended that the following operating and adjustment philosophy be adopted with respect to the Converter crystal frequencies. First, with respect to an operating philosophy. While the i-f (R-390A/URR receiver) frequencies assigned to the various stations are "bogeys", they are not sacred. This to say that should it be found that the signals with which you are concerned should be coming in with a slightly different receiver setting thanthis bogey, it will in no way affect the Sensitivity or effectiveness of the equipment, provided the proper receiver setting is once ascertained and known. The factor that might be annoying would be the lack of match between two Converters of a set, so that the switching of Converters would introduce an appreciable change in the required receiver setting. This is to say that as a matter of adjustment philosophy, it is believed that a frequency match between two Converters of a set is of more importance than the exact frequency of either of them. Fortunately it is much easier to match a pair than it is to attempt to put them exactly on frequency and provisions have been made in the equipments to permit this to be done.

Should it be found that a matching adjustment must be made, it will first be necessary to make up or otherwise procure an adjustment tool. This consists of a hollow socket wrench for a #2 nut, with a shaft at least six inches long, inside of which can be slid a thin screw driver with a knife-edge blade. This tool is required to reach, unlock and lock the adjusting screw which is well inside the cases of the units, as shown by an examination of Figure 13. The oscillator compartment is the one with the tube mounted horizontally. The adjusting screw in question is the outboard screw appearing directly above the serial number of the unit. The cases and the drawer frames behind the middle units have 1/2 inch holes in them directly in line with this screw, so that it can be reached from the outside by some dexterous "blind fishing". (There is a similar hole in the case of the other units in each drawer, but it must be removed from the drawer in order to reach it.) A second requirement is for a number of coaxial patch cords with BNC fittings.

The matching procedure is premised on the fact that if two frequencies quite close together are introduced into the input of the R-390A/URR receiver, they will both pass through and one will beat with the other in the final demodulator, just as if it were a BFO. Therefore, it is only necessary to feed both inputs of two Converters (in parallel) from a signal generator adjusted to the input frequency involved and a beat note will be obtained from the receiver connected to their two outputs, the frequency of which is the frequency difference between the two Converter oscillators. Ad advantage of this method is that an appreciable frequency drift or "wobble" in the signal generator frequency is innocuous, as it affects both Converters simultaneously. Only the frequency difference of the oscillators is involved. The receiver should, of course, be operated with its BFO off and in a wide-band (8 or 16 kc) condition.

Accordingly, should either of the sets of Converters show a frequency divergence sufficiently great as to warrant an attempt at readjustment, it will be necessary to remove the drawer from the rack in order to gain access to the adjustment hole in its rear frame, reconnecting the power to it. Then unplug the coax cables from both the input and output receptacles on the converters. With coax patch cords and "tees", parallel the two outputs and connect to the Receiver input. Similarly, parallel the two inputs and connect to the Signal Generator. Tune the Generator to the center of the input frequency band involved and you should hear a beat note. (The use of AGC and the Carrier Level meter will assist in this tuning operation).

Then go through the hole near the center of the rear of the drawer with the special socket wrench and screw driver and "fish" for the oscillator adjusting screw. When located, loosen the lock nut and adjust the slug screw until zero beat is obtained, relocking the lock nut. In theory this is quite simple. In practice it is most difficult inasmuch as not only is the slug adjustment very critical, a small fraction of a turn making a marked frequency shift, but even the strain of tightening the lock nut will change the frequency. The operation is strictly one of trial and error and care must be taken to assure that you haven't thrown the oscillator out of audio range rather than to zero beat. Similarly, care must be exercised in not attempting to turn the slug screw with the lock nut partially tightened, or there is the danger of breaking off the slotted screw end (the screw being only a brass 2/56).

Change of Converter Tubes

Should it be necessary to change any of the Converter tubes, it is well to keep in mind that the r-f circuit tuning capacitance is the capacitance of the r-f tubes and that a new tube even though it might have a higher G_m and lower Noise Figure may often actually reduce the Sensitivity of a Converter when substituted in a socket unless its associated circuit is retuned by the slug adjusting screws on the top of the unit. Therefore, in making tube changes it is always wise to "retouch" these tuning adjustments for maximum gain.

SECTION 11

OPERATING PROCEDURE

- 0 -

The facilities covered by this Instruction Manual are so flexible and the uses to which they might be put are so diversified that exact and detailed operating procedures will depend to a great extent on the particular mission to which they might be put. Accordingly, no attempt will be made to delineate any specific operating procedures herein. However, such instructions will be prepared and furnished the interested activities in the form of STANDARD OPERATING PROCEDURES for each particular mission involved.

SECTION 12

NOTES ON TROPICALIZED HUT

- 0 -

12.1 OPERATION OF THE AIR CONDITIONER

12.11 Power Connections

The air conditioner is intended for operation on 240 volts, 60-cycle single phase ac. The nearest 240-volt receptacle for obtaining this power is the one normally used for the heaters in the standard Huts. Accordingly, when air conditioning is required, the heater should be unplugged and the conditioner plugged in its place. It is believed fair to assume that both units will not be required to operate at the same time.

12.12 Treatment of Thermostat

In all the Huts a thermostat is mounted on the side of the main power panel just as one enters the door. The contacts of this Thermostat are permanently cut in series with the 240-volt circuit for controlling the heater. It will obviously control any device that is plugged into this 240-volt circuit. In weather sufficiently hot to require air conditioning, this would make the conditioner unit inoperative. To correct this situation, a S. P. D. T. toggle switch has been mounted just above the Thermostat in the Tropicalized Hut , marked "THERMOSTAT, ON - OFF". When in the OFF position the Thermostat contacts are "shorted", keeping the 240-volt circuit alive at all times. Accordingly, when using the Air Conditioner, keep this switch in the OFF position; the thermostat built into the conditioner will then take over. If the heater is required and is substituted for the Air Conditioner, throw it to the ON position.

12.13 The Control Panel

The control panel for the air conditioner is located behind the left hand section of the intake grating which is hinged on the left and opens as a door.

Unfortunately, the frame spacings of the Hut were such as to preclude the cutting of a sufficiently wide opening to permit the Conditioner to be installed partly within the enclosure as intended, but required gasketing the face of the Conditioner to the outside skin. This restricts the opening of the door for access to the control panel to approximately 75 degrees. This is sufficient to permit of their operation, but care should be exercised not to force this door which would result in its damage.

12.14 Change of Air Filter

Because of the mounting restrictions explained in 12.13 above, access to the air filter is blocked by the gasket on the outside of the Hut. Accordingly, when a change or cleaning of the air filter is required, it will be necessary to slide the Conditioner back on its shock-proofed mounting plate a sufficient distance to gain access to the filter. To accomplish this it will first be necessary to remove the positioning angle from the mounting plate behind the Conditioner. In replacing the unit, be sure that it is pushed hard against its gasket before rebolting the angle.

12.2 THE SUN CANOPY

12.21 Its Care

A high degree of the effectiveness of the Sun Canopy rests in its reflecting quality in deflecting the rays of the sun. Therefore, unless some serious factor of excessive corrosion should arise, the exterior surface of this canopy should never be painted, and then only a light color.

12.22 Access to Antennas

It will be noted that a section of the "over-hang" of the canopy has been omitted on one side opposite the antenna mast. This is to permit access to the canopy from a ladder should any work be required on the antennas. However, the design and bracing of the canopy is such that it will not carry the weight of a man without distortion and damage. Therefore, in order to permit minor maintenance work to be done on the antenna, the

section of the canopy between the entrance slot and the mast has been made of extra heavy plate (section M-1 Figure 32), with the cross bracing members spaced approximately twelve inches apart. Accordingly, if a man will restrict his movements to this section and keep his feet as close to the center stiffening ridge as possible without stepping on it, no damage will result, although the plate may feel slightly springy under foot.

12.23 The Use of Ladders

It will be noted that the canopy plates are only .051 inch in thickness and are amply strong for rain or wind loading. However, they extend over the outer framing an appreciable distance and will not take the weight of a ladder without serious distortion. Therefore, never use a ladder resting against the canopy overhand, although a ladder used in the access slot will rest against the canopy framing and is entirely satisfactory. See Figure 33.

SECTION 13

MAINTENANCE

-0-

13.1 THE ELECTRONIC EQUIPMENT

The electronic equipment should require very little maintenance other than periodic changes of electron tubes when any should fail after extensive use. As a general premise, it is considered unwise to promiscuously change electron tubes unless one or more have definitely failed or the performance of any unit shows an appreciable decrease. Once the characteristics of an electron tube have established themselves after the first fifty hours or so of operation, an old tube is more likely to give satisfactory performance than a new tube. Furthermore, in some cases, such as in the Converters, where the tube capacitance is the principal circuit capacitance, a change of tubes usually necessitates the retuning of the circuit in which it is placed; an operation to be avoided if at all possible.

The Instruction Books for each of the various units of electronic equipment, which have been made available to the various stations, contain complete instructions for the maintenance of the specific units they cover so that any attempt to supplement this information would be redundant.

13.2 LUBRICATION

All of the various fan motors in the huts or their equipments have sealed or self-lubricating bearings and require no periodic lubrication. However, the upper mast bearing, which is a large pin-type roller bearing, should be relubricated every three months or more frequently should circumstances so indicate. The roof plate that contains this bearing is equipped with two Alemite fittings located several inches forward of the mast on the inside ceiling of the hut. Don't over-lubricate - two or three strokes of the lubrication gun should be sufficient. A grease gun and two tubes of grease have been provided with the equipments to permit the lubrication of these bearings.

13.3 WATER TIGHTNESS

The upper mast bearing assembly was well caulked at installation prior to shipment of the huts and should not leak over long periods of time. However, in the event any leakage should occur, a caulking gun and a tube of caulking compound have been included in each shipment, to be used as and when required. In this connection, leakage of water through or around this bearing assembly does not always appear at the point of leakage but may run between the two skins of the hut and appear at some other point.

13.4 ANTENNA HAND BRAKE ADJUSTMENT

The antenna brake is similar to that employed as a Parking Brake in many automobiles that operate on the transmission. Considering the relatively small amount of use that it will get in service, it should not require readjustment over long periods of time. Its readjustment requires a special tool to reach through an opening in the pedestal casting below the operating table. One of these tools has been furnished with each shipment and is tagged "BRAKE ADJUSTING TOOL".

To effect an adjustment of the hand brake requires a certain amount of ingenuity and practice plus a knowledge of the mechanism involved. The description of this mechanism and the adjustment procedure that follows is predicated on viewing the mast pedestal below the operating table from the front.

The stud that adjusts the diameter of the brake band and hence the drum clearance runs transversely to the pedestal about two inches in from the front with the adjusting nut approximately centered with respect to the pedestal. The adjusting nut therefore turns either toward or away from you.

This "nut" is, in reality, a round member about one inch in diameter with the outside milled with a multiplicity of slots similar to a spline. These slots, in addition to providing means for turning the "nut" by "prying" on them with the adjusting tool furnished, also serve as detents for a spring retainer which exerts too much pressure to permit the "nut" to be turned with the fingers.

In the front of the pedestal below the table will be found a rectangular slot approximately four inches long and three inches high. If one runs his fingers along the upper side of this slot, (palm up) they will be guided by a closure for

about 1 1/2 inches when they will enter the interior of the pedestal. Immediately inside, if one cups his fingers slightly, will be felt the splined bottom of the adjusting nut described above. Pulling these splines toward you tightens the brake shoes, pushing them away from you loosens the brake. As mentioned above, the spring tension is too great for finger movement. However, the brake adjusting tool supplied has the two ends bent at such angles that one may be used as a pry-bar for tightening and the other for loosening the nut. A little experimentation will indicate which end provides the best leverage for the respective movements. It is impossible to see the adjusting nut through the pedestal opening, but there is ample room to use the fingers of one hand in guiding the end of the adjusting tool into the slots.