Corps J-Boy Poppy

Move by

~~CONFIDENTIAL~~

20 Dec 1963

SPECIAL INSTRUCTIONS FOR INSTALLATION OF ANTENNA STEERING UNIT IN COMMAND HUTS

1. In Command Huts special installation procedures are required in order to remove the Antenna Diode Lobing Switch from the antenna circuit during transmission of command signals. Matched cable pairs are required from the right and left hand pairs of the Channel "A" Yagi antennas to the diode switch. This requirement prevents the use of the T-R relay in the transmitter and necessitates the addition of a T-R relay in each antenna lead. To facilitate installation in these cases the Antenna Lobing Switch and associated components are mounted on a plate inside the hut. The following paragraphs outline the procedure for the modification.

2. Antenna Lobing Switch Plate Installation

The Antenna Lobing Switch plate is a 12 x 27 inch sheet of 1/4 inch aluminum on which are mounted the diode switch, two coaxial relays (K601 and K602) and a terminal board (T601). This plate is to be mounted on the hut bulkhead below the operating table behind the antenna mast. (See section D-D Encl Dwg.) Mounting is accomplished by inserting the four 5/16-18 inserts in the hut wall as shown and attaching the plate with 1/2 inch long 5/16-18 cap screws. Hold plate in place after locating wall members and mark four hole locations. Use the center punch and pilot drill, enlarge hole with 1/2-inch dia drill and then use 33/64 dia drill to finish hole to correct size. Tap into hole the Southco wall inserts and screw into inserts the torque type expander tool and tighten tool with wrench. Remove tool, mount plate and screw in 5/16-18 bolts. The expander tool looks like a square head set screw with a bullet shaped nose.

3. Antenna Lead-In Modifications

Remove the existing matching cables (YSL 5 120-140) which connect the right and left hand pairs of Yagis on the lower cross arm to the TEE attached to the mast fitting. These will be replaced by the seven-foot cables (601 and 602) supplied. Remove the two antenna down lines which run through to the base of the mast. Save the data link cable (attached to upper antennas) as it must be reinstalled. Replace these with the two thirteen-foot cables (603 to 604) supplied and connect cable 602 from the right hand pair of Yagis

GEN-CO-0012-94

~~CONFIDENTIAL~~

to the lower mast fitting and cable 601 from the left pair of Yagis to the upper mast fittings (middle mast fitting of three are available).

Attach cable from lower starboard Yagi pair to the "IN" jack on relay K602. Attach cable from lower port Yagi pair to the "IN" jack on relay K601. Connect transmitter antenna cable to the TEE joining the two YSL-l 120 cables coming from the normally open (ANT 1) jacks of relays K601 and K602.

Remove from the "IN" jack of relay K403 the cable which goes to converter A. Connect this cable to the output jack of the Antenna Lobing Switch in the Diode Switch Plate.

Cable 605 connects the terminal board (T601) on the diode switch plate to the lobe switch jack (J309) which must be installed on the rear of the MTU. (See following paragraph for instructions.) Attach cable 606 to the ADU installed in the converter rack.

Re-install data link lead in cable using upper mast entrance fitting (where 3 are available). Where provision is made for only two cables to enter the mast a third mast entrance fitting must be installed for the data link antenna cable. This fitting should be installed in the upper mast section (aluminum) approximately one foot above the lower cross-arm. To do this, first bolt fitting to the mast, then mark and drill hole for cable entrance. This hole must be large enough to clear UG21 D/U connector. Install data link lead-in (be sure it is long enough) and attach antenna matching sections, as before, to a TEE on the new mast fitting.

4. MTU Modifications

Remove BNC jack (J308) from the rear of the MTU. (Do not remove connecting wire from MTU.) Enlarge this hole and install 3 pin Winchester jack (J309) supplied, in this position. Connect the yellow wire to a convenient ground lug. Connect pin 6 of J301 to pin 6 of J302 and attach green wire from Winchester jack (J309) to this point. Parallel pins 19 of J301 and J302 and connect this point to the -27 volt tie point on standoff behind the 2N555 power transistor. (Lavender wire) Drill a 7/16-inch hole immediately below the Winchester jack (J309) and reinstall BNC jack (J308 PTT).

~~CONFIDENTIAL~~

5. Transmitter Modification.

On both "X" and "Y" transmitters proceed as follows: remove back cover from the power supply (lower unit) and find loose wire (taped end). This wire must be connected to pin 19 of jack J202. To perform this operation it may be necessary to loosen (DO NOT REMOVE) the mounting post for the AC power input plug in order to release tension on the braid grounded under this post.

~~CONFIDENTIAL~~

PRELIMINARY

Installation, Operation and

Maintenance Instructions for

ANTENNA STEERING SYSTEM

NOTE: This manual to be replaced by a more complete book at a later date.

CONFIDENTIAL

~~CONFIDENTIAL~~

ANTENNA STEERING SYSTEM

1. INSTALLATION INSTRUCTIONS

1.1 Azimuth Deviation Unit - This unit is to be installed in the converter rack in the position shown in Figure 1.

1.2 Azimuth Error Meter - This unit is to be installed on the front corner post of the left table rack, as shown in Figure 1. It should be centered approximately 14 inches above the table top.

1.3 Antenna Lobing Switch - This unit replaces the type "N" tee connector at the top of the mast. Use the "U" bolt furnished to mount the unit on the mast just below the top cross arm casting, at a position where the two cables from the antennas will connect to the two type "N" fittings near the top of the switch.

1.4 Mast Stuffing Tube For Control Cable

1.4.1 12-Foot Hut - Remove the blank plate from existing cable entry block shown in Figure 2 and install the adapter plate and gasket with four #8-32 flat head screws. Drop the weighted nylon fish cord through the cable entry hole down the base of the mast. Locate the fish cord through the cable port in the side of the mast base and tie on the cable marked ADU-1. Pull approximately 8 feet of the cable up through the cable entry hole, thread on the nylon stuffing tube housing, small nylon, washer rubber insert, two larger nylon washers and nylon packing gland nut. Tighten the stuffing tube housing in the adapter plate and install the various parts of the packing gland and nut leaving about 8 feet of cable for subsequent installation up the top mast section and into the lobing switch.

1.4.2 8-Foot Hut - An extra cable entry hole was not provided on the 8-foot hut mast. A single cable entry block is to be installed just above the first step on the top section of the mast, as shown in Figure 2. Mount the new block with two 1/4-20 X 3/4 stainless steel screws. Mark for location, remove the block and drill a 1/2 inch hole in the mast for cable ADU-1 to pass through. Elongate and chamfer the hole by slowly tilting the drill up to about 45 degrees after breaking through. Use a small round file to remove burrs and to make the hole smooth. Install the block, adapter plate, gasket, cable and stuffing tube as above for the 12-foot hut.

~~CONFIDENTIAL~~

1.5 Cable Installation

1.5.1 Remove the lobing switch from its mounting plate by backing out the 3/8-inch center mounting bolt. Install the ADU-1 cable in the stuffing gland in the side of the switch and connect the shield and conductors to the proper terminals in the switch. Tighten the stuffing gland and re-install the switch on the mounting plate at the top of the mast, being careful not to over-tighten the center mounting bolt.

1.5.2 Connect the two existing upper antenna cables to the upper connectors on the lobing switch. Connect the existing channel "A" antenna down cable to the bottom connector on the lobing switch. Secure these cables within 12 inches of the lobing switch with several wraps of Scotch 33 electrical tape.

1.5.3 Start at the lobing switch and secure the ADU-1 cable to the mast at 3 points between the switch and the cable entry block. Pull excess cable back into the hut and tighten the stuffing gland. Route the ADU-1 cable through the plastic wire ducts to the Azimuth Deviation Unit in the converter rack and connect to J-1.

1.5.4 The ADU-2 cable is to be installed as follows: Remove the cable marked "LDD A DRIVER IN 42L" from the terminal marked "A DRIVER IN" at the left rear of the LDD unit in the converter rack. Install an elbow and a tee on the "DRIVER IN" connector. Connect cable "LDD A DRIVER IN 42L" to one end of the tee. Connect one end of cable ADU-2 to the tee and the other end to J2 on the Azimuth Deviation Unit in the same rack.

1.5.5 Connect the ADU-3 cable from the Azimuth Deviation Unit to the Azimuth Error Meter, routing the cable through the wire ducts.

1.5.6 Install the ADU power cable in the back of the converter rack and plug it in the strip on the side of the converter rack. Make sure that the power cable does not interfere with other units in the rack which pull out for servicing.

2. ANTENNA STEERING SYSTEM

2.1 General - This antenna steering system has been devised and constructed to aid in steering the antenna array of the NRL huts. It will give the operator a sense of the direction and relative amount of azimuth error. This will substantially eliminate the signal loss experienced when the antenna is swung off-target during attempts to maximize signals.

2.2 Prinicple Of Operation - This system is composed of three units: (a) Azimuth Deviation Unit (ADU), (b) Antenna Lobing Switch, and (c) Azimuth Error Meter.

2.2.1 The Azimuth Deviation Unit (ADU) contains the transistorized electronics of the system and is mounted in the hut Converter Rack. The ADU consists of the following: (a) i-f amplifier-detector, (b) narrow-band filter, approximately 16 cycles center frequency and about two cycles wide, (c) phase detector, (d) multivibrator, (e) two diode switch drivers, (f) power supply.

2.2.1.1 The i-f amplifier-detector is connected to the receiver i-f output to amplify then amplitude detect this signal.

2.2.1.2 The narrow-band filter passes only the modulation impressed on the signal by the Antenna Lobing Switch.

2.2.1.3 The phase detector compares the phase of the modulation to the reference signal generated by the multivibrator.

2.2.1.4 The multivibrator generates a bipolar square wave of approximately 16 cycles. This wave is used as the phase reference and is applied to the switch drivers.

2.2.1.5 The switch drivers are two transistor amplifiers which, with the associated components, shape the waves and furnish the required voltages and currents to the Antenna Lobing Switch.

2.2.1.6 The power supply furnishes the proper voltages to the ADU.

2.2.2 The Antenna Lobing Switch is contained in a weatherproof housing mounted near the top of the antenna mast, (except in special cases). It consists of a "single-pole, double-throw" diode configuration and an antenna phasing line. The phasing line is connected between the port and starboard "Channel A" Yagis, and combines the induced voltages in such a way as to skew the beam approximately six degrees to either side of the boresight. The direction of skew depends upon which end of the phasing line is connected to the receiver system. This, in turn, depends on which diode is biased to conduct.

The diodes are biased to conduct alternately by the switch driver amplifiers. The conducting diode is biased negative approximately two-tenths of a volt and draws 20 milliamperes. In the back direction, or non-conducting state, the diode is biased approximately six volts positive.

The operation of the Antenna Lobing Switch, by alternately switching the antenna beam about six degrees either side of boresight amplitude modulates the "Channel A" signal with sixteen-cycle square waves. The depth, or percentage modulation, is related to the amount of antenna aiming error, being zero on boresight and increasing as the deviation from boresight increases. The phase of the modulation determines from which side of boresight the signal originated.

2.2.3 The Azimuth Error Meter is mounted next to the "Channel A" receiver and consists of a 100-0-100 microammeter and a switchable capacitor. The meter indicates the direction of and the relative antenna aiming error. The capacitor can be switched across the meter to increase the meter time constant. Its use is a matter of operator preference.

~~CONFIDENTIAL~~

3. DETAILED DESCRIPTION

3.1 Azimuth Deviation Unit (ADU) - Controls and functions

TABLE 1

CONTROL	FUNCTION
FRONT PANEL	
POWER Switch, S1	OFF - ADU power off POWER - ADU power on
LOBING Switch, S2	OFF - Multivibrator used to drive ANTENNA LOBING SWITCH is inoperative. LOBING - Multivibrator connected for ooeration.
LOBING RATE - P13	Multivibrator frequency control. Tunes multivibrator frequency to bandpass filter frequency for maximum sensitivity of ADU.
METER ZERO - P14	Matches diode resistance in PHASE DETECTOR for zero reading on AZIMUTH ERROR METER.
GAIN - P10	Controls sensitivity by varying I-F AMPLIFIER gain.
REAR PANEL	
SWITCH CURRENT ADJ. #1 - P11, #2 - P12	Fine adjustment for ANTENNA LOBING SWITCH diode "ON" currents.
~~VOLTAGE ADJ. - P14~~	~~Minimizes audio noise due to ANTENNA LOBING SWITCH.~~
CAL.-OPERATE Switch - S3	CAL. - Connects the LOW FREQUENCY AMPLIFIER to a calibration voltage from the MULTIVIBRATOR attenuator output. OPERATE - Connects DIODE DETECTOR to LOW FREQUENCY AMPLIFIER for ADU operation.

~~CONFIDENTIAL~~

4. INITIAL ADJUSTMENT PROCEDURES

4.1 Azimuth Deviation Unit (ADU)

4.1.1 An initial check of the Antenna Steering System installation is desirable before adjustment procedures on the ADU are begun.

4.1.2 Connect ADU input power plug to 105-115 volts, 60 cps power source.

4.1.3 Turn POWER switch, S1, to the POWER position.

4.1.4 Azimuth Error Meter zero adjustment:

4.1.4.1 Turn CAL.-OPERATE switch, S3, to the OPERATE position.

4.1.4.2 Turn LOBING switch, S2, to the LOBING position.

4.1.4.3 With no i-f signal into the ADU (i.e., "Channel A" R-390 FUNCTION switch in STANDBY position), adjust the METER ZERO control, P14, for a zero reading on the Azimuth Error Meter.

4.1.5 LOBING RATE adjustment:

4.1.5.1 Turn LOBING switch, S2, to the LOBING position.

4.1.5.2 Turn CAL.-OPERATE switch, S3, to the CAL. position.

4.1.5.3 Adjust the LOBING RATE control, P14, for maximum deflection on the Azimuth Error Meter. This reading should be between 50 and 90 microamperes.

4.1.6 ANTENNA LOBING SWITCH current adjustment

4.1.6.1 Turn LOBING switch, S2, to the LOBING position.

4.1.6.2 Turn CAL.-OPERATE switch, S3, to the OPERATE position.

4.1.6.3 Insert a milliammeter (minimum full scale reading of 10 ma) into SWITCH CURRENT MONITOR jack, J4, plug tip is positive, and adjust the current through diode #1 to 10 ma by varying the SWITCH CURRENT ADJ control, P11.

4.1.6.4 Remove milliampmeter from J4 and insert into jack, J5. Adjust the current through diode #2 to 10 ma using SWITCH CURRENT ADJ. control P12.

4.1.6.5 Remove milliampmeter from jack.

4.1.7 After completion of the initial adjustments, the ADU is ready to be used as a functional part of the Antenna Steering System. It should be noted that there are certain limitations in operating the R-390 as an integrat part of the Azimuth Antenna Steering System. The control settings and an explanation of the limitations of the R-390 and ADU are contained in the following paragraph.

4.1.8 For normal operation, the following R-390 settings are pertinent.

4.1.8.1 FUNCTION switch in the AGC position or MGC position.

4.1.8.2 AGC switch in the SLOW position. CAUTION. The ADU will not operate correctly with the AGC switch in the FAST position. Since the ADU works on the difference in magnitude and phase of the signals received from a switched antenna beam, a continuous reading of zero on the Azimuth Error Meter would occur because of the almost constant magnitude of the i-f signal from the R-390 with the AGC switch in the FAST position.

4.1.8.3 There are certain limitations of the Antenna Steering System when the R-390 FUNCTION control is in the MGC position. With the R-390 FUNCTION control in the MGC position, the RF GAIN controls the sensitivity of the ADU. Care must be taken not to overload the R-390 or the i-f amplifier of the ADU. In such instances, a continuous reading of zero is noted on the Azimuth Error Meter.

4.1.8.4 All other R-390 controls can be set at any desired position agreeing with standard operating procedures.

4.1.9 ADU control settings for normal operation

4.1.9.1 POWER switch, S1, in POWER position.

4.1.9.2 LOBING switch, S2, in LOBING position.

4.1.9.3 CAL.-OPERATE switch, S3, in OPERATE position.

4.1.9.4 Under normal operation GAIN control, P10, can be used to adjust ADU sensitivity as desired by the operator. ~~This adjustment has been preset such that a difference in signal strength of 2 db gives a 10 ma reading on the Azimuth Error Meter.~~ After any change in the GAIN control setting (or R-390 RF GAIN) the antennas should be steered very slightly off target in order to obtain a reading other than zero on the Azimuth Error Meter. If a continuous reading of zero is obtained, decrease I-F AMPLIFIER gain.

4.1.10 Trouble shooting - field maintenance level

4.1.10.1 The trouble shooting and repairs that can be performed on the field maintenance level are limited in scope by the test equipment and parts available at the installation. Field maintenance is, therefore, concerned with the determination of system troubles which can be corrected with the parts available.

~~CONFIDENTIAL~~

4.1.11 Trouble shooting

4.1.11.1 Table 2 gives a list of possible ADU troubles, their cause, and corrective measures to be taken. For R-390 trouble shooting procedures refer to Standard Operating Procedures Manual and/or the receiver handbook.

TABLE 2 - ADU TROUBLE SHOOTING CHART

TROUBLE	CAUSE	CORRECTION
1. Excessive switching noise due to ANTENNA LOBING SWITCH	Antennas off target	Steer on target.
	DC voltage adjustment incorrect	Monitor voltage on VOLT MONITOR jack, J7, with an oscilloscope set for 5v/cm and 10 ms/cm time scale. While listening to switching noise through receiver head set, adjust VOLT. ADJ. control, P15, until spikes on voltage waveform are equal to approximately 1/2 volt. This should minimize the audible noise with the switching voltage still operating properly. CAUTION. Do not increase VOLT. ADJ., P15, until there is no switching noise. In such a case the ANTENNA LOBING SWITCH does not function and both diodes are forward biased. After adjustment of VOLT. ADJ. control, repeat initial installation adjustment procedure for ANTENNA LOBING SWITCH current.

~~CONFIDENTIAL~~

TABLE 2 - ADU TROUBLE SHOOTING CHART (CONT'D)

TROUBLE	CAUSE	CORRECTION
2. Continuous zero reading on Azimuth Error Meter	LOBING switch, S2, in OFF position	Turn LOBING switch to LOBING position.
	I-F INPUT disconnected.	Check I-F output from R-390 receiver through cable "ADU#2"
	I-F AMPLIFIER overloaded	Monitor I-F Test connector with oscilloscope. Waveform should contain modulated signal. Correct by decreasing I-F AMPLIFIER GAIN or RF GAIN on R-390.
	ANTENNA LOBING SWITCH diodes burned out.	Plug milliammeter into SWITCH CURRENT MONITOR jacks J4 and J5. A reading of zero would indicate open circuit. A reading of 20 ma would indicate either a shorted diode or malfunction of the switching voltage.
	Switching voltage not working	Check waveforms at LOBING SWITCH jack, J1. With ANTENNA LOBING switch removed, the waveforms (voltage) should be square waves with +6v as diode reverse bias voltage and -4v as diode forward bias voltage. Correct by decreasing power supply voltage using VOLT. ADJ. P15. After adjustment of P15, repeat ANTENNA LOBING SWITCH current adjustment.

TABLE 2 - ADU TROUBLE SHOOTING CHART (CONT'D)

TROUBLE	CAUSE	CORRECTION
3. Continuous reading other than zero on Azimuth Error Meter	Antennas off target	Steer antennas until a zero reading is noted on Azimuth Error Meter.
	CAL.-OPERATE switch, S3, in CAL. position	Turn to S3 to OPERATE position.
	One of the diodes in ANTENNA LOBING SWITCH open circuited	Plug milliammeter in SWITCH CURRENT MONITOR jacks J4 and J5. A reading of zero milliamps indicates that diode should be replaced.
	Azimuth Error Meter not set at zero.	Repeat initial Azimuth Error Meter zero adjustment.

~~CONFIDENTIAL~~

AZIMUTH DEVIATION UNIT NOTES

1. Install Antenna Lobing Switch on front side (i.e., side closest to signal) of antenna mast. Do not cross antenna leads. This will insure proper direction of meter deflection. All cables and connections have been checked for correct polarity.

2. When installing Antenna Switch, the inside terminal connections are easily made before mounting the switch.

3. If meter deflects to right, turn antenna handwheel to left to bring meter to zero. After ascertaining that system is operating correctly, it will be found that antenna side lobes will give opposite control. Alert operators to this method of side lobe identification.

4. Normal operating conditions:

4.1 Set negative supply voltage to 3.6.

4.2 Total current should be between 95 and 110 ma with lobing switch on and antenna switch operating at 10 ma per side.

4.3 Antenna diodes both conduct at 20 ma when Lobing Switch is off. Total current under this condition should be approximately 130 ma.

5. Set receiver rf gain control so that a meter deflection of about 50 microamps results from about 3 to 5 degrees antenna error. It will be noticed that the Lobing Switch chops the signal when antenna error is significant, and this chop is unnoticeable when error is close to zero. This effect is quite helpful in steering.

6. Be sure that receiver Function Switch is on AGC and AGC Time Constant is on slow.

7. Tune Channel "A" receiver for maximum signal on Line Meter. BFO can be either OFF or ON. Bandwidth, 4 or 8 kc. Four kc gives a slight improvement in sensitivity but dial will need correcting more often.

~~CONFIDENTIAL~~

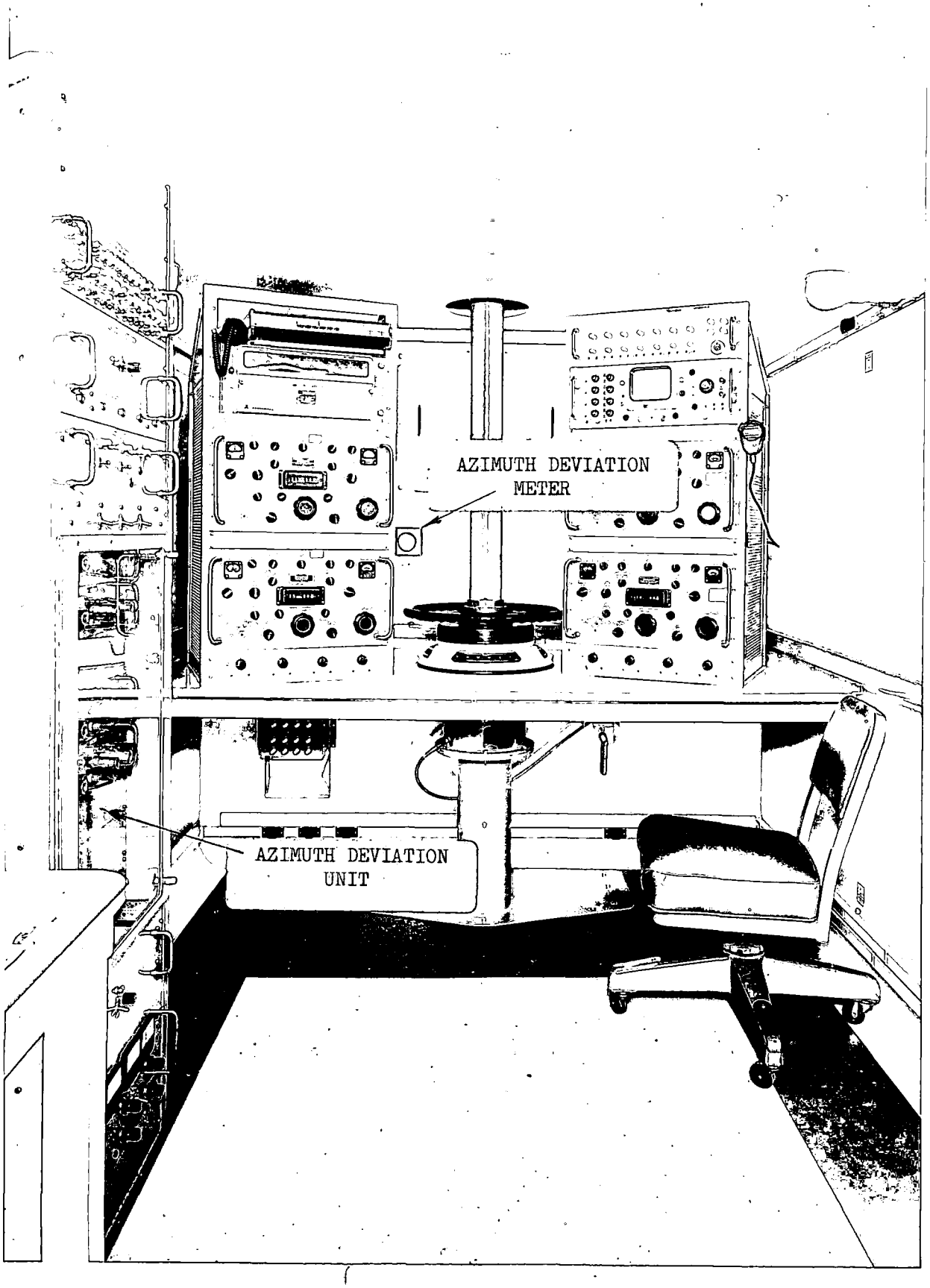
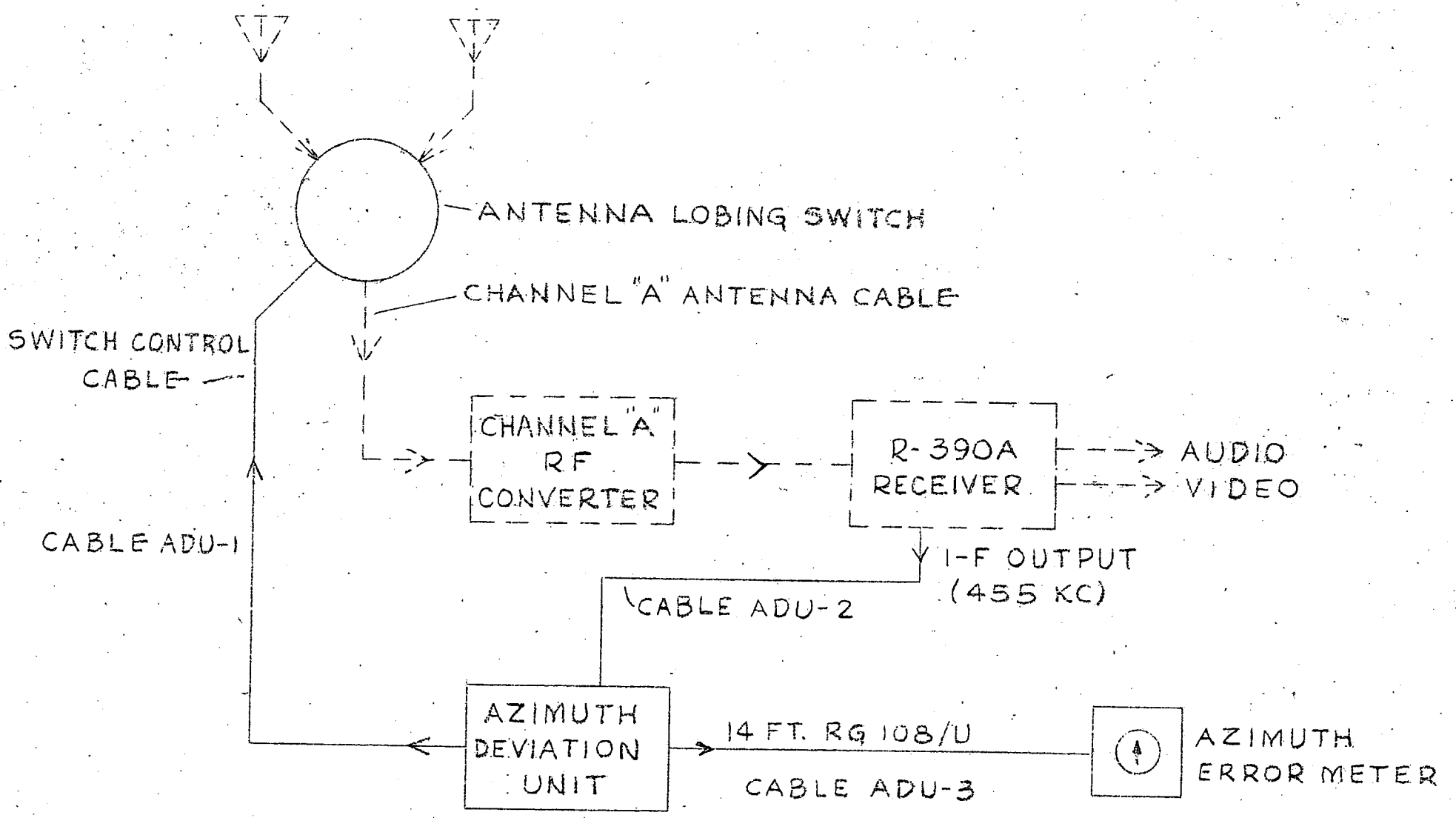


FIGURE 1

DOTTED LINES DENOTE EXISTING EQUIPMENT AND CABLES



AZIMUTH DEVIATION SYSTEM BLOCK DIAGRAM

11-26-63

Approved for Release: 2021/04/20 C05025733

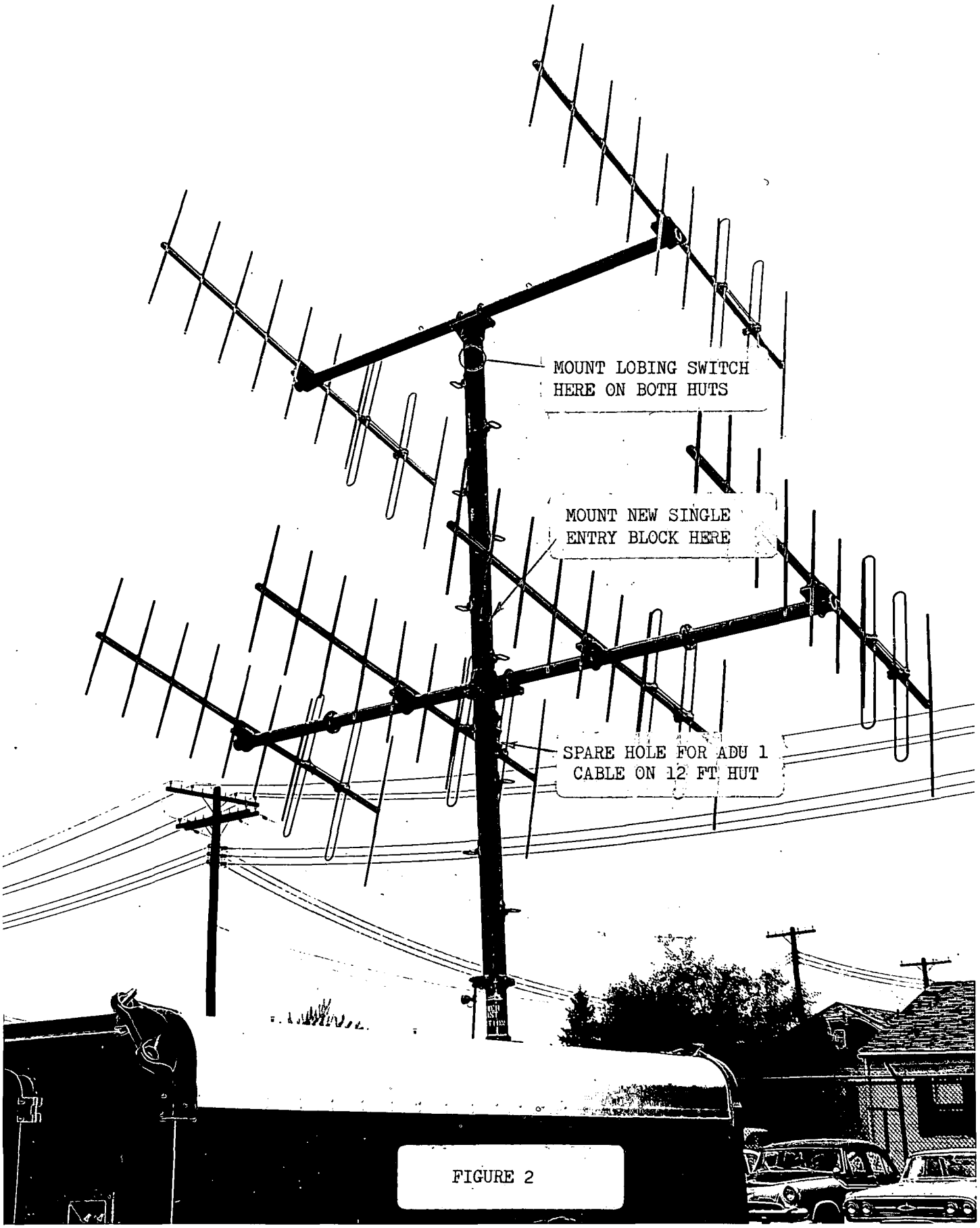


FIGURE 2