NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE TECHNOLOGY APPLICATIONS

Task 27
December 16, 1969

INSTALLATION, OPERATION, AND MAINTENANCE PROCEDURES FOR AN/TNS-9 MOD II OMNIDIRECTIONAL SOUND LOCATING SET

JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CALIFORNIA

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INSTALLATION, OPERATION, AND MAINTENANCE PROCEDURES FOR AN/TNS-9 MOD II OMNIDIRECTIONAL SOUND LOCATING SET

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CONTENTS

SECTION

I. INTRODUCTION 1

PART ONE - INSTALLATION PROCEDURES

II. ERECTION OF RECEIVING ANTENNA 3

A. EQUIPMENT REQUIRED FOR ANTENNA ERECTION 3

1. Screw Anchor Sites 3

2. Tower Site 5

B. TOOLS REQUIRED FOR ANTENNA ERECTION 5

C. SELECTION AND PREPARATION OF SITE 6

D. PREPARATION OF TOWER EQUIPMENT 6

E. PREPARATION OF ANTENNA ASSEMBLY 8

F. ERECTION OF TOWER AND ADJUSTMENT OF GUY WIRES 11

G. GUY WIRE ADJUSTMENTS 14

H. LOWERING THE TOWER AND DISASSEMBLY 15

III. LAND LINE INSTALLATION 17

A. EQUIPMENT REQUIRED FOR LAND LINE INSTALLATION 17

B. TOOLS REQUIRED FOR LAND LINE CONNECTIONS 17

C. SOUND CENTRAL SYSTEM CONNECTIONS 18

D. ARRAY CONNECTIONS 18

IV. SOUND CENTRAL EMPLACEMENT 21

A. EQUIPMENT REQUIRED FOR SOUND CENTRAL EMPLACEMENT 21

B. TOOLS REQUIRED FOR SOUND CENTRAL EMPLACEMENT 21

C. SITE SELECTION 21

D. SETUP PROCEDURE 22

V. ARRAY DEPLOYMENT 23

A. EQUIPMENT REQUIRED FOR ARRAY DEPLOYMENT 23

B. TOOLS AND ACCESSORIES FOR ARRAY DEPLOYMENT 25

CONTENTS (Contd)

C. RESONANT CAVITY ASSEMBLY 25
D. CAVITY PLACEMENT AND ALIGNMENT 28
E. YAGI ANTENNA ASSEMBLY AND ERECTION 34
F. FINAL ARRAY ASSEMBLY 36
G. ARRAY DISMANTLING AND DISASSEMBLY PROCEDURE 38

PART TWO - OPERATION PROCEDURES

VI. MANUAL DATA ENTRY 39
A. EQUIPMENT REQUIRED 39
B. TOOLS REQUIRED 39
C. DATA ENTRY 39
VII. INITIALIZATION PROCEDURE 43
A. EQUIPMENT REQUIRED 43
B. TOOLS REQUIRED 43
C. DETAILED PROCEDURE 43
VIII. BOOTSTRAP LOADING PROCEDURE 45
A. EQUIPMENT REQUIRED 45
B. TOOLS REQUIRED 45
C. DETAILED PROCEDURE 45
IX. SYSTEM PROGRAM LOADING PROCEDURE 49
A. EQUIPMENT REQUIRED 49
B. TOOLS REQUIRED 49
C. DETAILED PROCEDURE 49
X. THREADING AND OPERATING PAPER TAPE READERS 51
A. EQUIPMENT REQUIRED 51
B. TOOLS REQUIRED 51
C. OPERATING CONTROLS 51
D. TAPE LOADING 53
E. SELF-THREADING REELS 54
F. MALFUNCTION 54
G. BROKEN TAPE 55
H. TAUT TAPE 55

CONTENTS (Contd)

PART THREE - MAINTENANCE PROCEDURES

SECTION

XI. ARRAY PRETEST INSPECTION 57
A. EQUIPMENT REQUIRED 57
B. TOOLS REQUIRED 57
C. DETAILED PROCEDURE 57

XII. ARRAY TROUBLESHOOTING PROCEDURE 61
A. EQUIPMENT REQUIRED 61
B. TOOLS AND ACCESSORIES REQUIRED 61
C. DETAILED PROCEDURE 61

APPENDIXES

A. DETAILED EQUIPMENT LIST 65
B. DETAILED DRAWING LIST 69
C. TOOLS AND SUPPORT EQUIPMENT 73
D. SPARES AND EXPENDABLES 75

FIGURES

1. Selection and marking of site for receiving antenna 4
2. Attachment of shackle and grab hook to screw anchor 7
3. Arrangement and sequence of wires in guy-as-you-erect procedure 9
4. Details of locking arm released from lock and engaged with section stop 12
5. Antenna tower with mast and five sections in raised positions 13
6. Landline installation, SCS 19
7. Array landline installation 20
8. Deployment of array sensors and Yagi antenna 24
9. Microphone adapter connection 26
10. Microphone installation 27
11. Wind screen base and tripod 29
12. Tripod adjustment 31
13. Resonant cavity installation 32

CONTENTS (Contd)

FIGURES

14. Wind screen attached to base with bungee cord 33
15. Yagi antenna and mast 35
16. Arrangement of grounding rod, RES box, power supply and lightning arrestor 37
17. Manual data entry panel 40
18. Computer control console 46
19. Paper tape reader 52
20. Electronics for RES 62
21. Drawing list 71

TABLE

1. Catalog of manual data entry functions 41

SECTION I

INTRODUCTION

This document provides the procedures developed for training Army personnel to install and operate the AN/TNS-9 Mod II Omnidirectional Sound Locating Set. Procedures were not prepared for those portions of the support equipment provided by JPL that would normally be provided as part of base support equipment. Maintenance procedures are limited to operational checks and do not cover hardware repair.

PART ONE

INSTALLATION PROCEDURES

SECTIONS II THROUGH V

SECTION II

ERECTION OF RECEIVING ANTENNA

The receiving antenna installation consists of a THD-542K tower, a 15-ft mast antenna, and a tower erection kit. A five-man crew is recommended for the assembly and erection of the antenna. After assembly and erection have been completed, the receiving elements of the antenna are in a proper position for signal reception 50 ft above the ground.

A level site should be selected about 50 ft away from the instrumentation van. There must be 40 ft of clearance in three different directions, 120 deg apart, for the installation of guy wires. The actual procedures for erection of the tower can be divided into five general tasks. These five tasks, with the equipment and tools required, are described below.

A. EQUIPMENT REQUIRED FOR ANTENNA ERECTION

Unpack the following items of equipment and place them in designated areas (Fig. 1) before proceeding with erection.

1. Screw Anchor Sites

Three sets of the following items are required. One set should be placed at each of three screw anchor sites (A, B, and C) upon selection of the locations.

Anchor, screw, 4 ft or
Anchor, screw, 6 ft
Shackle
Hook, grab
Chain, 6-ft
Turnbuckle, large, with bolt and nut
Collector plate, guy wire

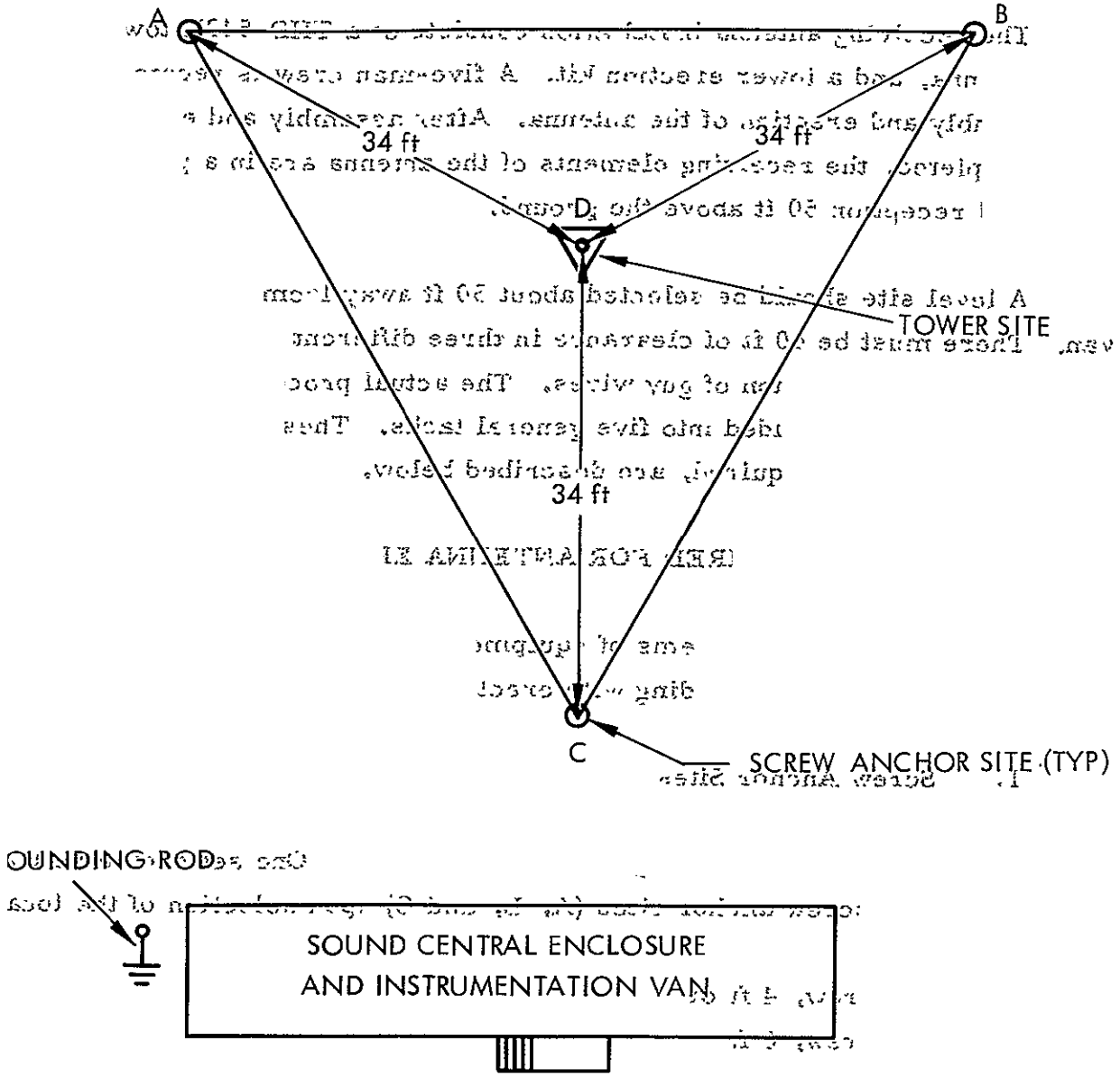

Fig. 1. Selection and marking of site for receiving antenna

2. Tower Site

The following items of equipment should be unpacked and prepared for ready access at the tower location.

Element, antenna (3 ea)
Hub, antenna, color coded for elements (1 ea)
Preamplifier (1 ea)
Tower, guy wires attached, 42 ft (1 ea)
Coaxial cable, antenna-to-preamplifier, 10 ft (1 ea)
Coaxial cable, preamplifier-to-receiver, 100 ft (1 ea)
Cable, power supply, 100 ft (1 ea)
Cable, antenna-to-ground, braided, 125 ft (1 ea)
Mast, antenna, 2-in. pipe, 20 ft (1 ea)
Collar, slip, with dacron cord (for support of antenna elements) (1 ea)
Tape, masking, heavy (for taping cables to guy wires) (1 ea)
Rod, support, antenna (1 ea)
Charge arrestor, static, pointed (1 ea)
Rope, hemp, 3/8-in., 50 ft (1 ea)
Base plate, tower (1 ea)
Bolt, hinge (1 ea)
Pin, cotter (2 ea)
Stake, metal shear (for securing plate to ground) (3 ea)

B. TOOLS REQUIRED FOR ANTENNA ERECTION

The following tools are needed by the 5-man crew for erection of the receiving antenna:

Wrench, crescent, 8-in., (3 ea)
Screwdriver, 6-in., regular tip (1 ea)
Screwdriver, 6-in., fine tip (1 ea)
Pliers, visegrip (1 ea)
Bar, steel, 4 ft (1 ea)
Hammer, sledge, 4 lb (1 ea)

C. SELECTION AND PREPARATION OF SITE

1) At approximately 50 ft from the instrumentation van (Fig. 1), mark a level site for the erection of the tower.
2) Ensure that there is 40 ft of clearance in the three directions that the screw anchors will be installed; 120 deg apart.
3) Place the tower base plate at the center of the tower site.
4) Mark a site for each of the three screw anchor sites 34 ft from the center of the tower site, using the corners of the triangular base plate for visual alignment.
5) Use a sledge hammer to drive three metal stakes in the holes provided to secure the base plate to the ground.
6) Depending upon the density of the ground, select either a 4- or 6-ft screw anchor, and install one at each of the three screw anchor sites using a 1-in pipe or a metal rod to rotate the screw anchor.

NOTE

If the soil is hard, moist, or has high clay content, use 4-ft anchors; if soil is loose or dry, use 6-ft anchors.

7) Attach a shackle and a grab hook (Fig. 2) to each screw anchor.

NOTE

Guy wires will be attached later during erection of the tower.

D. PREPARATION OF TOWER EQUIPMENT

1) Place the tower in a horizontal position hinge side down and facing the hinge side of the tower base plate.
2) Align the holes of the tower base inside the holes of the base plate and insert the hinge bolt.
3) Secure the hinge bolt by attaching cotter pins at both ends.
4) Lift the opposite end of the tower assembly (use three crewmen) and prop the end with the antenna support rod (approximately 4 ft high).

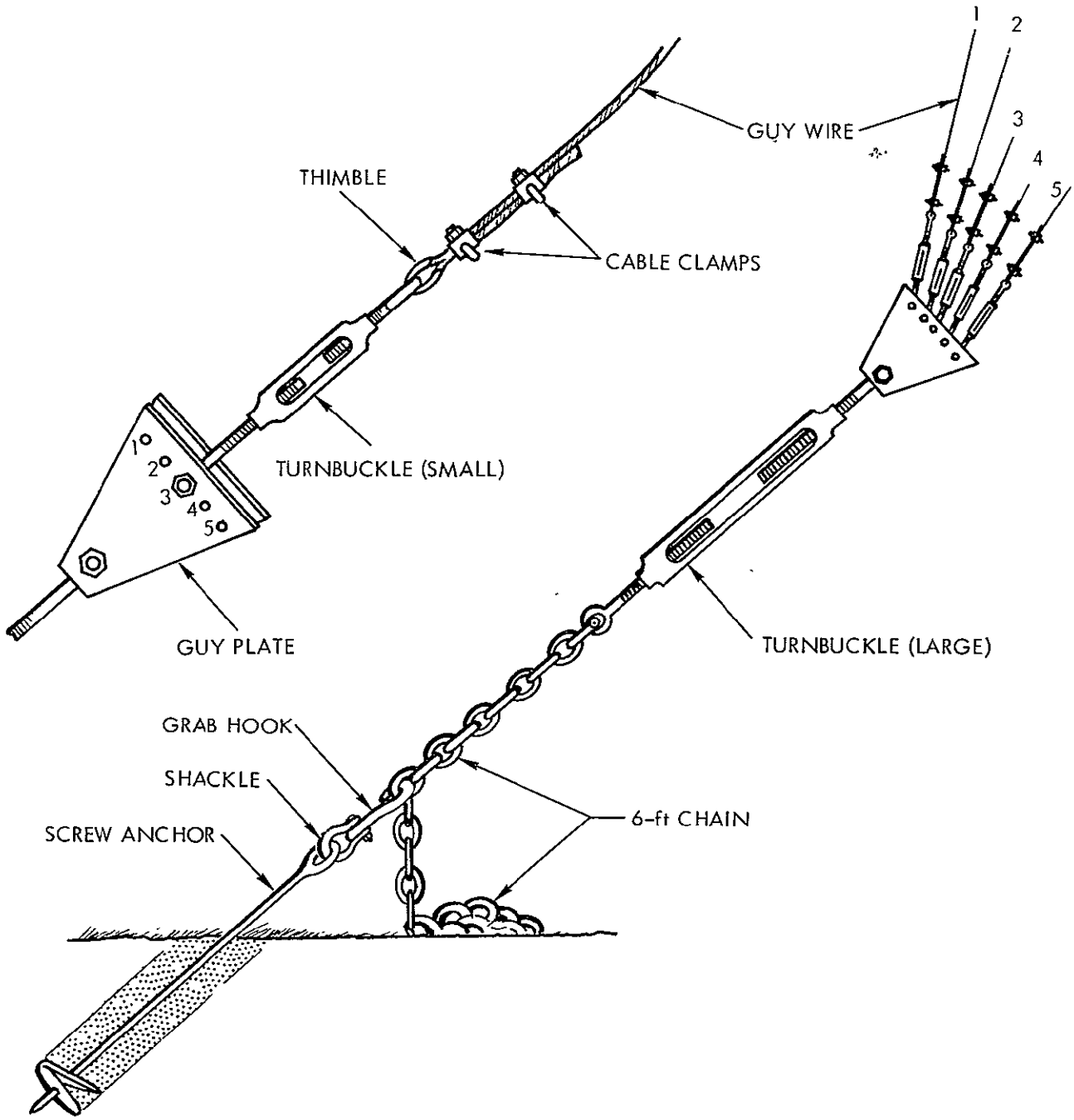

Fig. 2. Attachment of shackle and grab hook to screw anchor

5) Unwind the 15 guy wire loops attached to the top of each tower section (Fig. 3) and place them near the corresponding anchors A, B, and C.

6) Attach guy wires (with turnbuckles and eyes at ends) to the lowest positions of the respective guy wire collection plates at anchors B and C. (Anchor A guy wire is attached to a hinged locking arm instead of to the tower.)

7) Tie a 50-ft rope to the first section of the tower below the first locking arm and clear of the telescope until the second section is moved out of the stowed position during the erection of the tower.

8) Insert the eye of the large turnbuckle in the opposite end of the guy wire collector plate and secure the eye with the large bolt and nut provided for all anchor positions (both small and large turnbuckles should be in the half-open position).

9) Ensure that chains are loose at opposite ends of the large turnbuckles for later securing with grab hooks when the tower is raised to the vertical position.

E. PREPARATION OF ANTENNA ASSEMBLY

1) Place the antenna elements, the 20-ft mast, the preamplifier, the cables, the slip collar, and the accessories near the tower.

2) Slip the grounding cable downward between the fifth (top) and fourth tower sections, and up through the center of the top section.

3) Insert the grounding cable through the 20-ft mast section.

4) Attach the ground cable lug to the stud on the bottom of the pointed static charge arrestor.

5) Insert the pointed static charge arrestor into the end of the 20-ft mast, but do not insert the locking screw.

6) Insert the 20-ft mast into the guide collars in the top tower section (do not tighten the locking bolts).

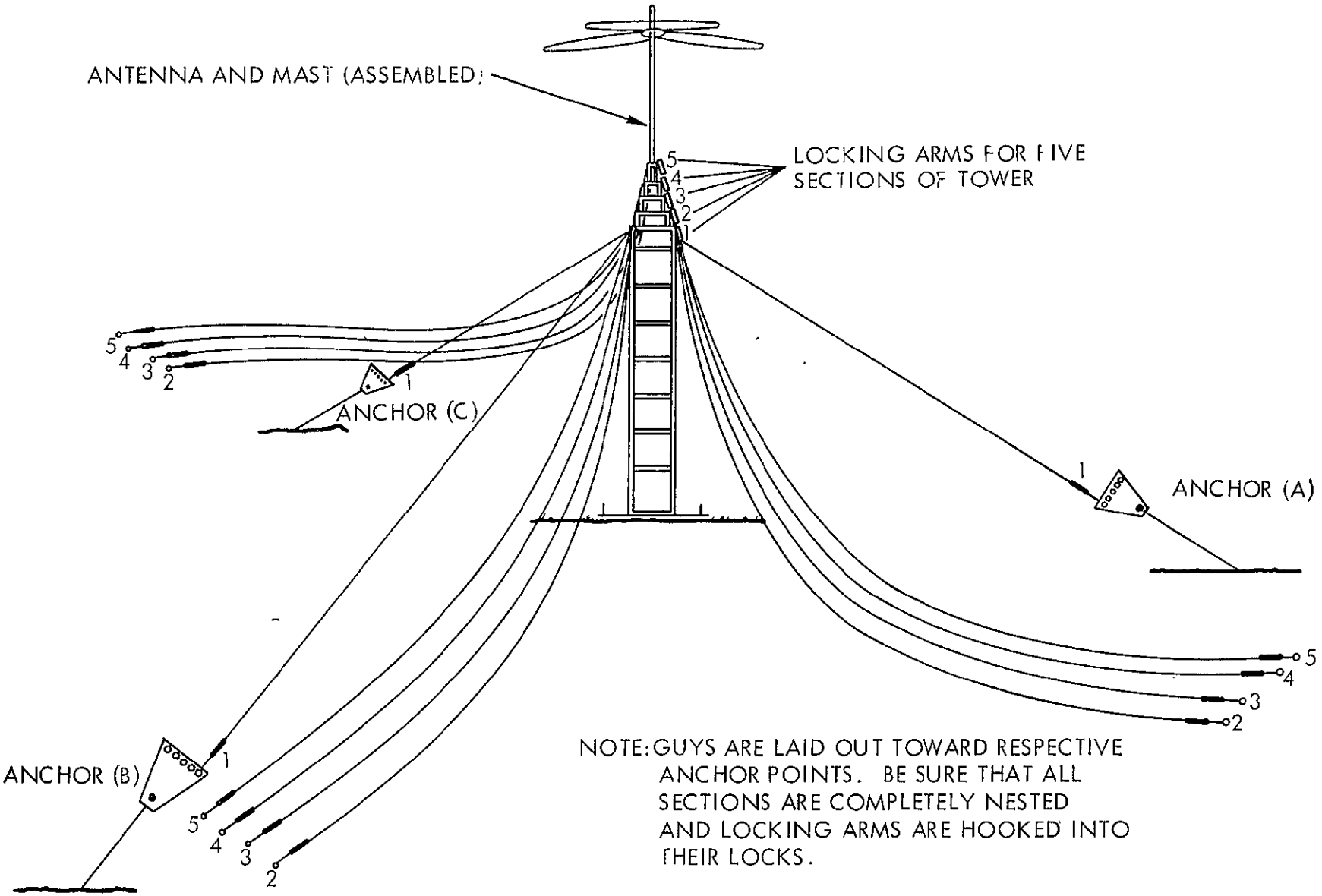

Fig. 3. Arrangement and sequence of wires in guy-as-you-erect procedure

7) Assemble the color-coded antenna elements, according to their corresponding positions, on the antenna hub.

NOTE

Two sets of antenna elements and two hubs (Nos. 1 and 2) are provided. Ensure that No. 1 set of antenna elements is assembled with the No. 1 antenna hub, and check the color coding before assembly.

8) Remove the nut and the bolt from the boss on the antenna hub.

9) Slip the antenna hub over the pointed tip of the mast, with the boss section of the hub on the lower end, to a point approximately 3 ft from the tip.

10) Insert the bolt through the boss and the hole in the mast and fasten with the nut. Attach the static discharge arrestor to the mast with its screw.

11) Attach the slip collar over the tip of the mast and secure all three antenna elements to the collar with dacron cord.

NOTE

Three holes are provided at the slip collar, and two anchor points with pin hooks are provided at each element for convenience. The mast should be rotated for access to all antenna elements.

12) Tighten the collar locking bolts on the 20-ft mast to lock it in place.

13) Attach the preamplifier box to the antenna mast under the hub and above the screw protruding from the mast. Secure the box to the mast with screw-type hose clamps, with the lower clamp against the screw, and tighten the clamps.

NOTE

The upper end of the preamplifier box has a coaxial jack for connecting the cable to the antenna hub. The lower end of the box has a jack for cabling (signal from the pre-amplifier) to the instrumentation van and a smaller jack for power supply from the van to the preamplifier.

14) Attach a short coaxial cable from the antenna hub to the top of the preamplifier box.

15) Secure the cables to the mast with heavy adhesive tape to prevent damage.

16) Attach a power cable and a long coaxial cable to the lower side of the preamplifier, and tape the cables to the mast to prevent damage.

F. ERECTION OF TOWER AND ADJUSTMENT OF GUY WIRES

1) Secure the signal, power supply, and grounding (braided) cables to the top guy wire closest to the instrumentation van.

2) Attach a grab hook of two anchors to a link of 6-ft chain at the end of two corresponding guy wire assemblies (Anchors B and C).

3) Use 50 ft of rope at the lowest section of tower (the rope corresponds to and temporarily supports the third guy wire assembly Anchor A Fig. 3).

4) Raise the tower with the mast attached to the upright position while one crewman holds the rope.

5) Tie the rope to the third anchor point temporarily.

CAUTION

Before starting to raise the tower, check the tower with a level to ensure that all sections are completely nested. Check that locking arms are hooked into their locks.

6) Turn the winch handle clockwise so that all sections in the first nest (Fig. 3) will raise together.

7) Continue raising sections until the locking arm on the bottom section is raised and snaps in under the section stops (painted red), which are under the second section (Figs. 4 and 5).

CAUTION

To avoid damage to the equipment, prevent the locking arms from extending beyond the required overlap between sections. Forcing sections against the welded stops may damage the cabling system.

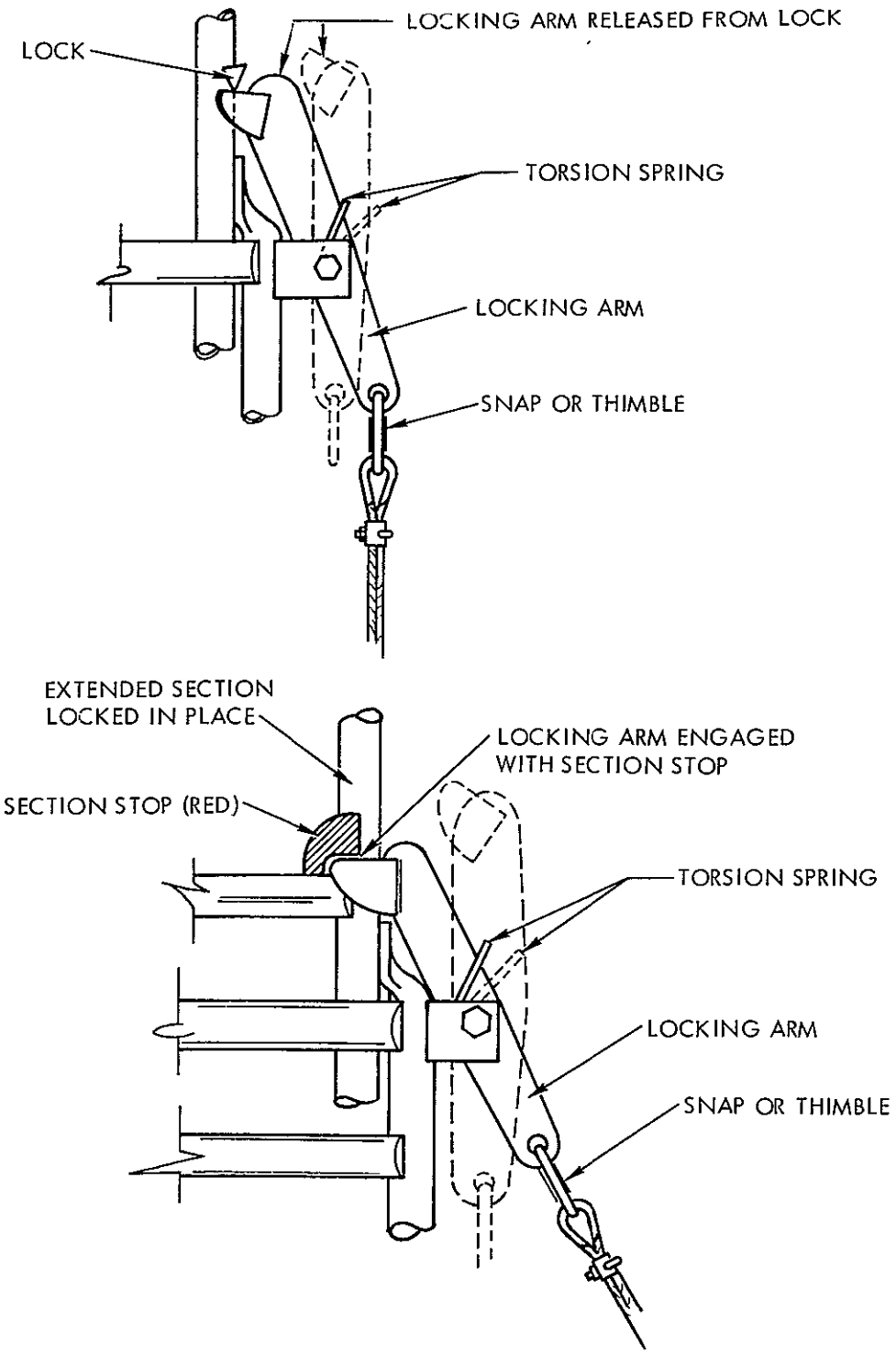

Fig. 4. Details of locking arm released from lock and engaged with section stop

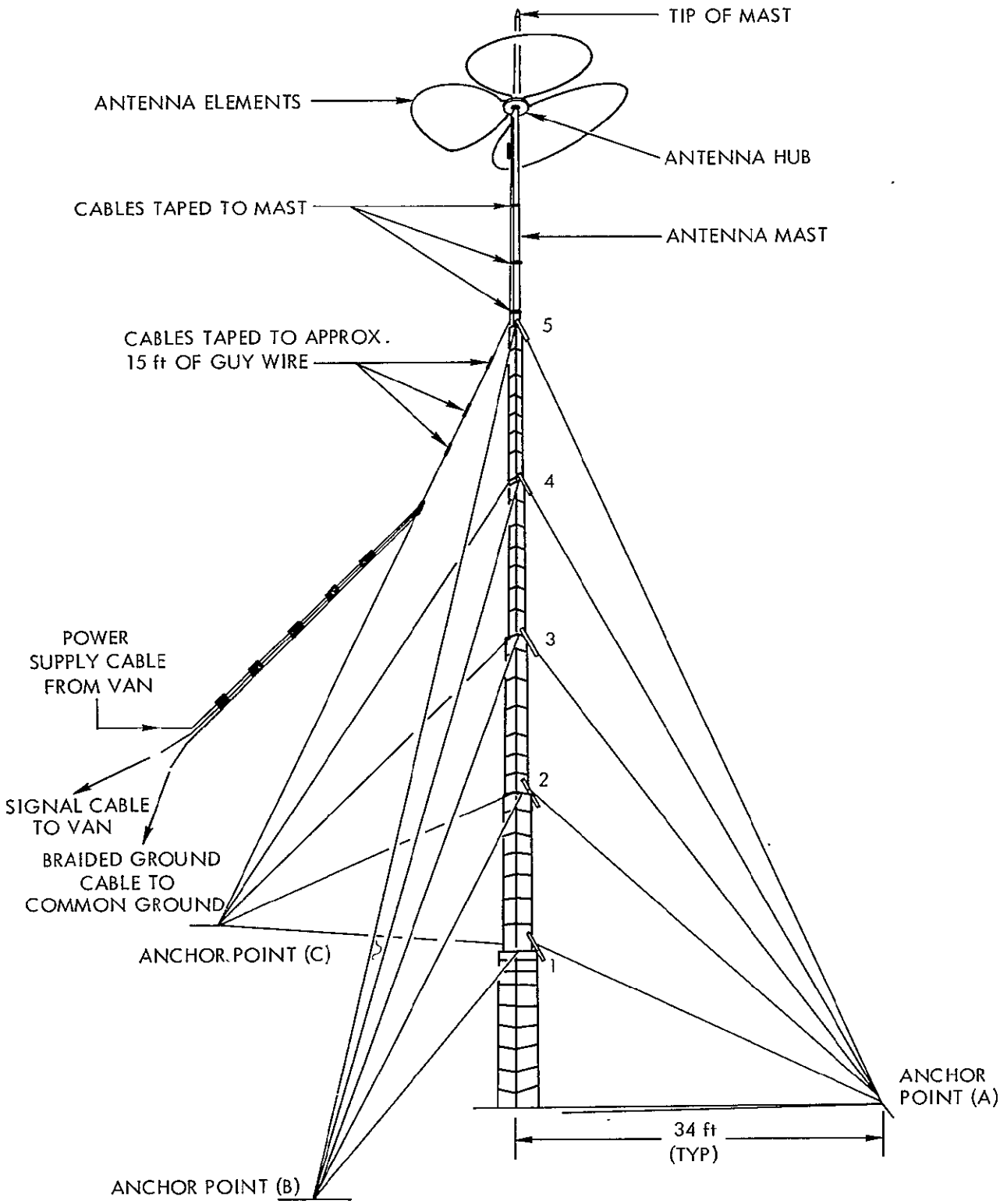

Fig. 5. Antenna tower with mast and five sections in raised positions

8) Connect the guy wire from the first section to Anchor point A and remove the rope.

9) Reverse the dog on the winch and lower the tower (turn winch handle counterclockwise) until the cable from the winch drum becomes slightly slack.

10) Bring the second cable from Anchor point A in toward the tower base and pull it to release the lock.

11) Reverse the dog on the winch and raise the next tower section until the locking arm engages under the stop.

12) Connect all guy wires for this section.

13) Repeat steps 9 through 12 until all sections are raised and locked in place.

CAUTION

Avoid either excessive tension or slack on guy wires. To keep tower plumb, a crewman at the base of the tower can sight up the section legs and call out the required adjustments to crewmen at the anchor points.

G. GUY WIRE ADJUSTMENTS

1) Check adjustments to the guy wires at all three anchor points (guy wires should have equal tension).

NOTE

If the slack in the guy wire is excessive, loosen the cable clamps (Fig. 2) for each wire and reduce their lengths as required.

2) Check that the tower is plumb.

3) Make final adjustments to obtain accurate tower plumb and proper cable tension with the large turnbuckles at the anchors.

4) Make cabling and grounding connections at the instrumentation van (Fig. 5).

APPENDIX A.2.3

Application of the Modified Quasilinearization Method

The nonhomogeneous linear, ordinary vector differential $\dot{z} = Az + B$ is composed of $n = 4$ linearized differential equations of motion (with the control eliminated by use of the optimality condition) and $n = 4$ linearized Euler-Lagrange equations. These equations are

$$\dot{z}_{1_{n+1}} = \dot{u}_{n+1} = \left(\frac{2v}{r}\right)_n v_{n+1} + \left(\frac{2GM}{r^3} - \frac{v^2}{r^2}\right)_n r_{n+1}$$

$$-\left[\frac{T\lambda_2{}^2}{m(\lambda_1{}^2+\lambda_2{}^2)^{3/2}}\right]_n \lambda_{1_{n+1}} + \left[\frac{T\lambda_1\lambda_2}{m(\lambda_1{}^2+\lambda_2{}^2)^{3/2}}\right]_n \lambda_{2_{n+1}}$$

$$+ (B_1)_n$$

$$\dot{z}_{2_{n+1}} = \dot{v}_{n+1} = -\left(\frac{v}{r}\right)_n u_{n+1} - \left(\frac{u}{r}\right)_n v_{n+1} + \left(\frac{uv}{r^3}\right)_n r_{n+1}$$

$$+ \left[\frac{T\lambda_1\lambda_2}{m(\lambda_1{}^2+\lambda_2{}^2)^{3/2}}\right]_n \lambda_{1_{n+1}} - \left[\frac{T\lambda_1{}^2}{m(\lambda_1{}^2+\lambda_2{}^2)^{3/2}}\right]_n \lambda_{2_{n+1}}$$

$$+ (B_2)_n$$

$$\dot{z}_{3_{n+1}} = \dot{r}_{n+1} = u_{n+1} + (B_3)_n$$

$$\dot{z}_{4_{n+1}} = \dot{\theta}_{n+1} = \left(\frac{1}{r}\right)_n v_{n+1} - \left(\frac{v}{r^2}\right)_n r_{n+1} + (B_4)_n$$

$$\dot{z}_{5_{n+1}} = \dot{\lambda}_{1_{n+1}} = \left(\frac{\lambda_2}{r}\right)_n v_{n+1} - \left(\frac{v\lambda_2}{r^2}\right)_n r_{n+1} + \left(\frac{v}{r}\right)_n \lambda_{2_{n+1}} - \lambda_{3_{n+1}}$$

$$+ (B_5)_n$$

$$\dot{z}_{6_{n+1}} = \dot{\lambda}_{2_{n+1}} = \left(\frac{\lambda_2}{r}\right)_n u_{n+1} - \left(\frac{2\lambda_1}{r}\right)_n v_{n+1}$$

$$+ \left[\frac{1}{r^2}(2v\lambda_1 - u\lambda_2 + \lambda_4)\right]_n r_{n+1} - \left(\frac{2v}{r}\right)_n \lambda_{1_{n+1}} + \left(\frac{u}{r}\right)_n \lambda_{2_{n+1}}$$

$$- \left(\frac{1}{r}\right)_n \lambda_{4_{n+1}} + (B_6)_n$$

H. LOWERING THE TOWER AND DISASSEMBLY

1) Remove the small turnbuckle and the eye from guy No. 4 at the guy plate of Anchor A, and bring the guy in toward the tower base.
2) Rotate the winch clockwise until the tower lock clears the locking arm.
3) Reverse the winch and pull downward on the guy wire.
4) Lower the tower section.

NOTE

The winch operator should watch the cable unwinding from the cable drum. If the cable slackens, the top section is not coming down, and the operator should pull the cable toward himself to free the section. If required, one of the top guy wires may be brought inward to the base of the tower and used to help pull the section downward.

5) Watch for the locking action of the locking arm on the next section as the top section nears nesting.
6) Ensure that the hook is at the top of the top section.
7) Lower the top section until it locks in place and the winch cable becomes slack.
8) Remove the turnbuckle and eye from the guy plate of Anchor A.
9) Repeat steps 2 through 8 until the tower is completely nested.
10) Lower the tower, using a 4-man crew, until it rests on the antenna support rod or on a sturdy box, approximately 4 ft high.
11) Perform the procedures in reverse order for preparation of the antenna assembly, the tower equipment, and the site.

SECTION III

LAND LINE INSTALLATION

Land lines shall be installed where possible for use as a backup data channel to the RF link. The land line itself is provided as part of the base support and is not included as part of the AN/TNS-9 system.

A. EQUIPMENT REQUIRED FOR LAND LINE INSTALLATION

The following items of equipment are required for connecting the land lines:

1) Sound Central Site

Arrestor box, lightning (2 ea)
Cable assembly, lightning arrestor-to-decoder (1 ea)
Ground strap, 3 ft (2 ea)
Field wire, twisted pair, from Sound Central System (SCS) to each array site

2) Each Array Site

Arrestor, box, lightning (1 ea)
Cable, RES-to-lightning arrestor, (1 ea)
Ground strap, (1 ea)

B. TOOLS REQUIRED FOR LAND LINE CONNECTIONS

Screwdriver, 6-in., regular tip (1 ea)
Stripper, wire (1 ea)
Wrench, crescent, 8-in. (1 ea)

C. SOUND CENTRAL SYSTEM CONNECTIONS

1) Attach the 3-ft ground strap to the lightning arrestor ground stud and the SCS ground stake (Fig. 6).
2) Strip 1/2 in. of insulation from the land line field wire coming from array #1 and attach to the LINE side of the lightning arrestor.
3) Connect the sound central cable from decoder channel 1 to the SYSTEM side of the same lightning arrestor position.
4) Repeat steps 2 and 3 until all land lines have been connected.
5) Stake or secure all land lines to prevent tension on the connections.

D. ARRAY CONNECTIONS

1) Attach the 3-ft ground strap to the lightning arrestor ground stud and the array ground stake (Fig. 7).
2) Strip 1/2 in. of insulation from the lead line field wire and attach to any LINE position on the lightning arrestor.
3) Attach the array land line cable to the SYSTEM side of the same lightning arrestor channel and to P2 on the RES.
4) Stake or secure the land line to prevent tension on the connections.

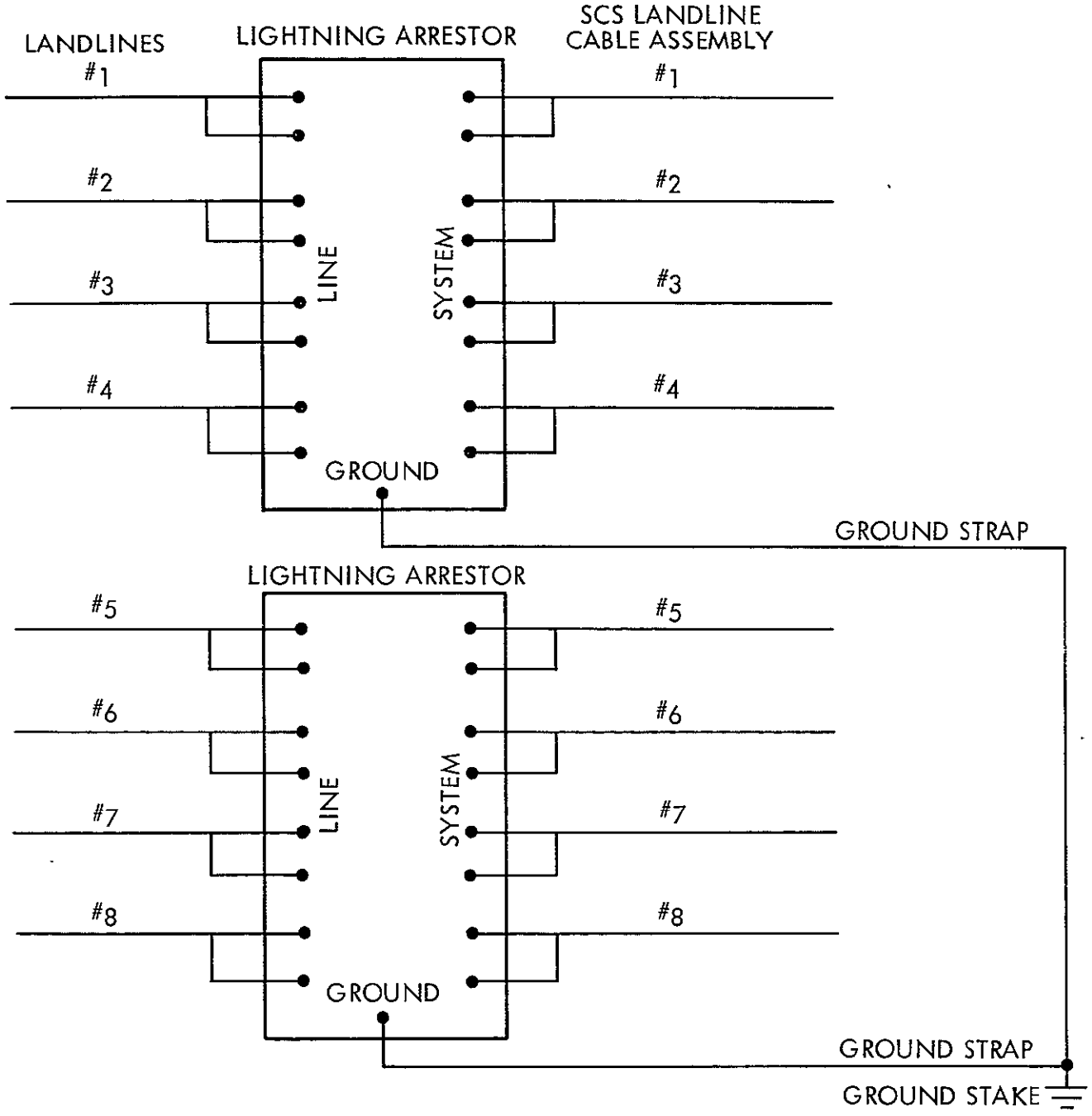

Fig. 6. Landline installation, SCS

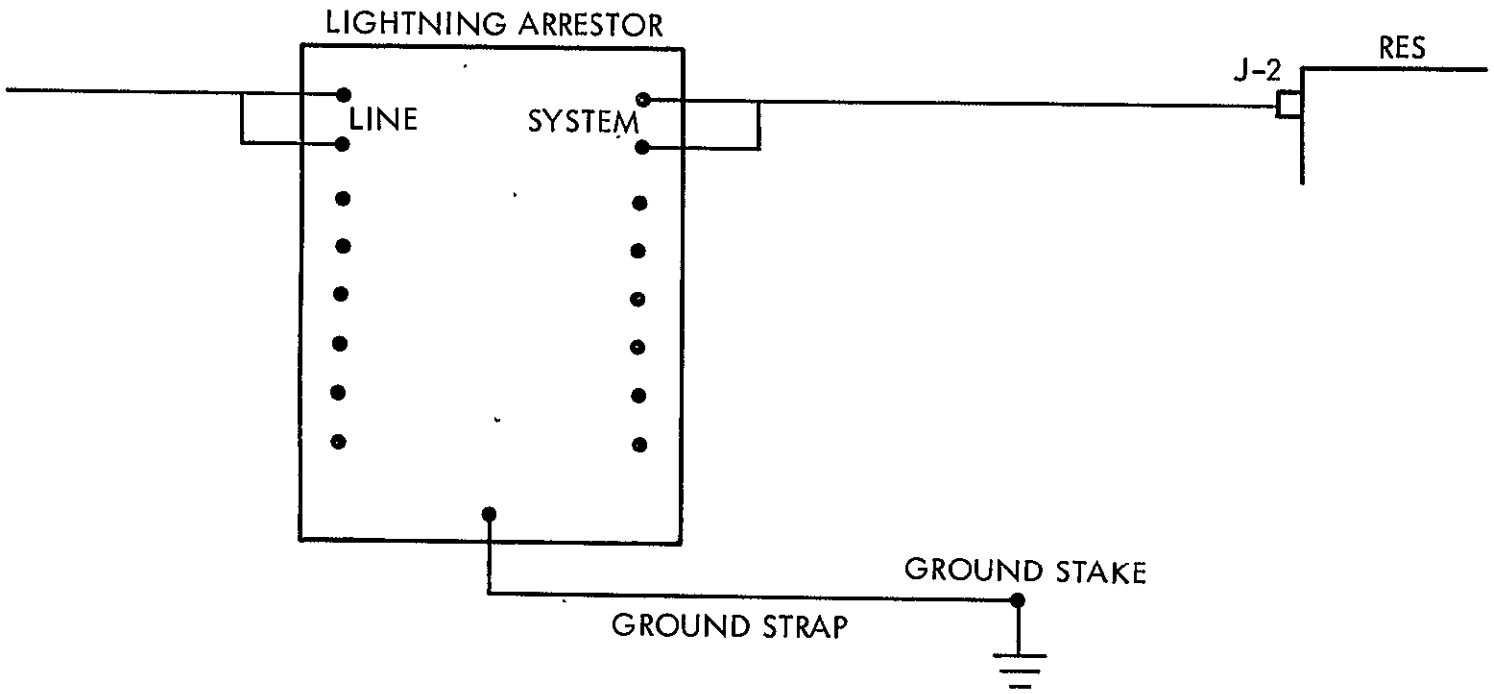

Fig. 7. Array landline installation

SECTION IV

SOUND CENTRAL EMPLACEMENT

The following installation procedure covers the general guidelines for emplacement of the sound central equipment.

A. EQUIPMENT REQUIRED FOR SOUND CENTRAL EMPLACEMENT

The basic equipment required for sound central emplacement is:

1) Sound central shelter.
2) Computer assembly; 620i.
3) Receiver decoder assembly.

B. TOOLS REQUIRED FOR SOUND CENTRAL EMPLACEMENT

Although the tools required for sound central emplacement are dependent upon the type of shelter and tiedown equipment, no special tools are required.

C. SITE SELECTION

The selection of the site for the sound central equipment should be based upon the following criteria:

1) The location should be near the center of the installation or near the center of the array line.
2) The sound central equipment should be located more than 2 km, but less than 16 km from any array.
3) A radio line of sight is required from the sound central location to each array.

D. SETUP PROCEDURE

Details on the actual setup are dependent upon the type of shelter used and upon local conditions. Since the shelter is not defined as part of the present equipment, the setup is not described herein.

SECTION V

ARRAY DEPLOYMENT

The array consists of four sensors, an encoder, and a transmitter. The sensors are deployed in a square configuration that is either 7.5, 15, 30, or 60 m on each side (Fig. 8), depending upon environmental conditions. The encoder converts the detected information to signals for telemetry transmission by means of the transmitter and the Yagi antenna.

A two-man crew is recommended for deploying a sensor array and for erecting the transmitting antenna associated with each array.

A. EQUIPMENT REQUIRED FOR ARRAY DEPLOYMENT

The array equipment required at each site consists of the following:

Box, resonant cavity components, containing
- Resonant cavities (4 ea)
- 25-Hz tuned stacks (4 ea)
- 50-Hz tuned stacks (4 ea)
- Microphones and adapters, Electro-voice, 630L (4 ea)
- Rain shields (4 ea)
- Bungee tiedown cords (4 ea)
- Ground stakes (12 ea)

Wind screen (4 ea)
Base, wind screen (4 ea)
Ground rod (1 ea)
Electronics, RES (1 ea)
Case, battery, with batteries (1 ea)
Antenna, Yagi, with mast (1 ea)
Box, support hardware, containing:
- Cables, RES to resonant cavity, (4 ea)
- Ground strap, 36-in., (2 ea)

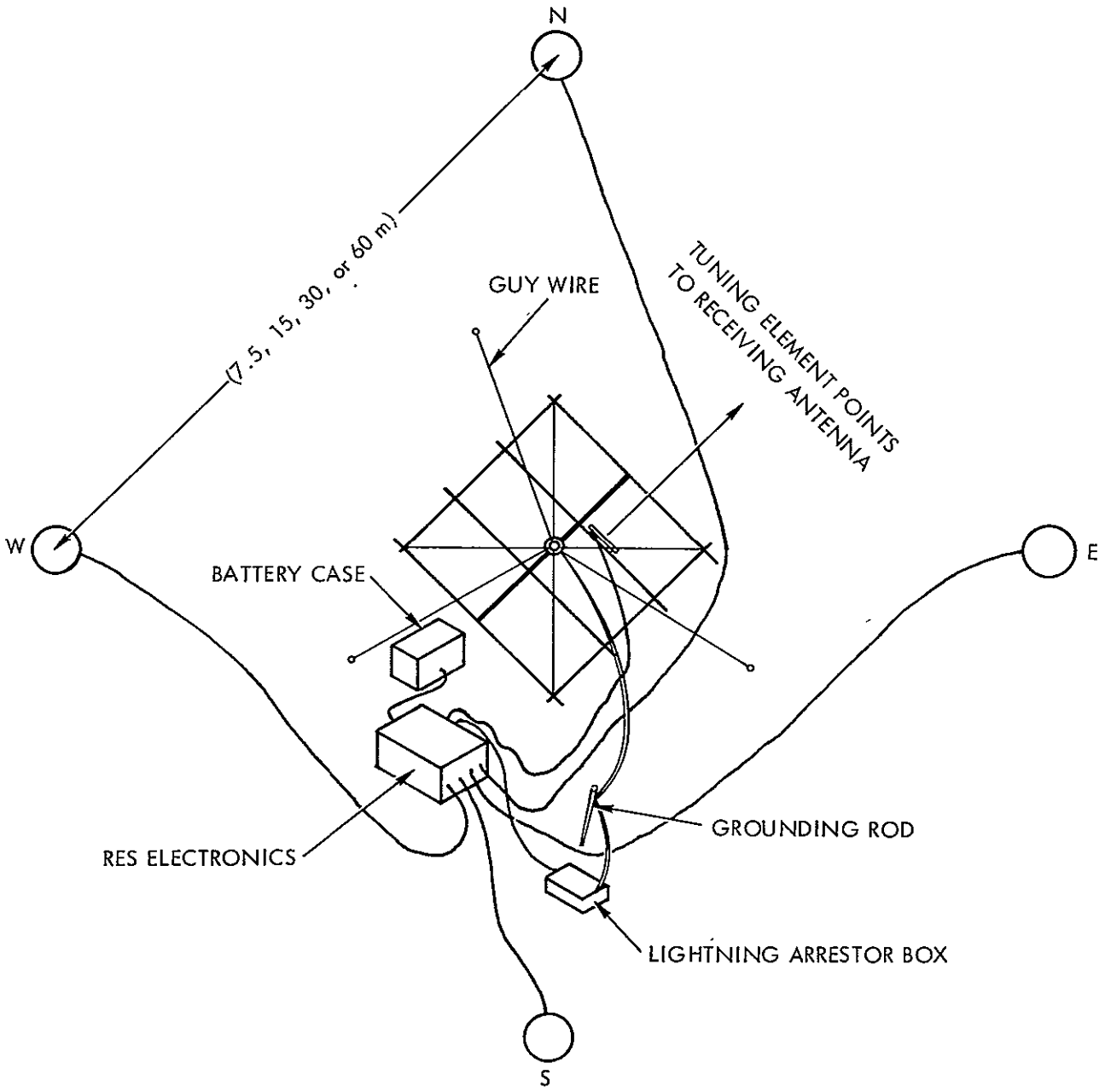

Fig. 8. Deployment of array sensors and Yagi antenna

Ground strap, 10-ft, (1 ea)
Ground strap, 25-ft, (1 ea)
Stake, antenna guy, (3 ea)
Wires, guy, (1 set)
Base, antenna , (1 ea)
Cable, coaxial, (1 ea)
Arrestor, lightning, (1 ea)
Cable, battery-to-RES, (1 ea)

B. TOOLS AND ACCESSORIES FOR ARRAY DEPLOYMENT

Tool, optical alignment, with tripod (1 ea)
Dispenser, reel (1 ea)
Reel, wire, with 2-conductor shield signal lines (1 ea)
Tape, 1-in. (1 spool)
Pliers, visegrip (1 ea)
Hammer, sledge, 4-lb (1 ea)
Wrench, crescent, 8-in., (1 ea)
Screwdriver, 6-in., regular tip (1 ea)
Screwdriver, 6-in., fine tip (1 ea)

C. RESONANT CAVITY ASSEMBLY

Perform the following operations at the box containing the resonant cavity components:

1) Attach one of the microphones to an adapter plate by attaching the terminals and hooking the spring (Fig. 9).
2) Insert the microphone and plate into the resonant cavity and fasten by installing the six screws (Fig. 10).
3) Place either the preselected 25- or 50-Hz stack in the resonant cavity and install the three wing nuts (Fig. 10).
4) Install the rain shield approximately 3 in. above the stack opening.
5) Stow the unused stack in the tube provided on the side of the resonant cavity.
6) Repeat steps 1 through 5 for each of the four resonant cavities.

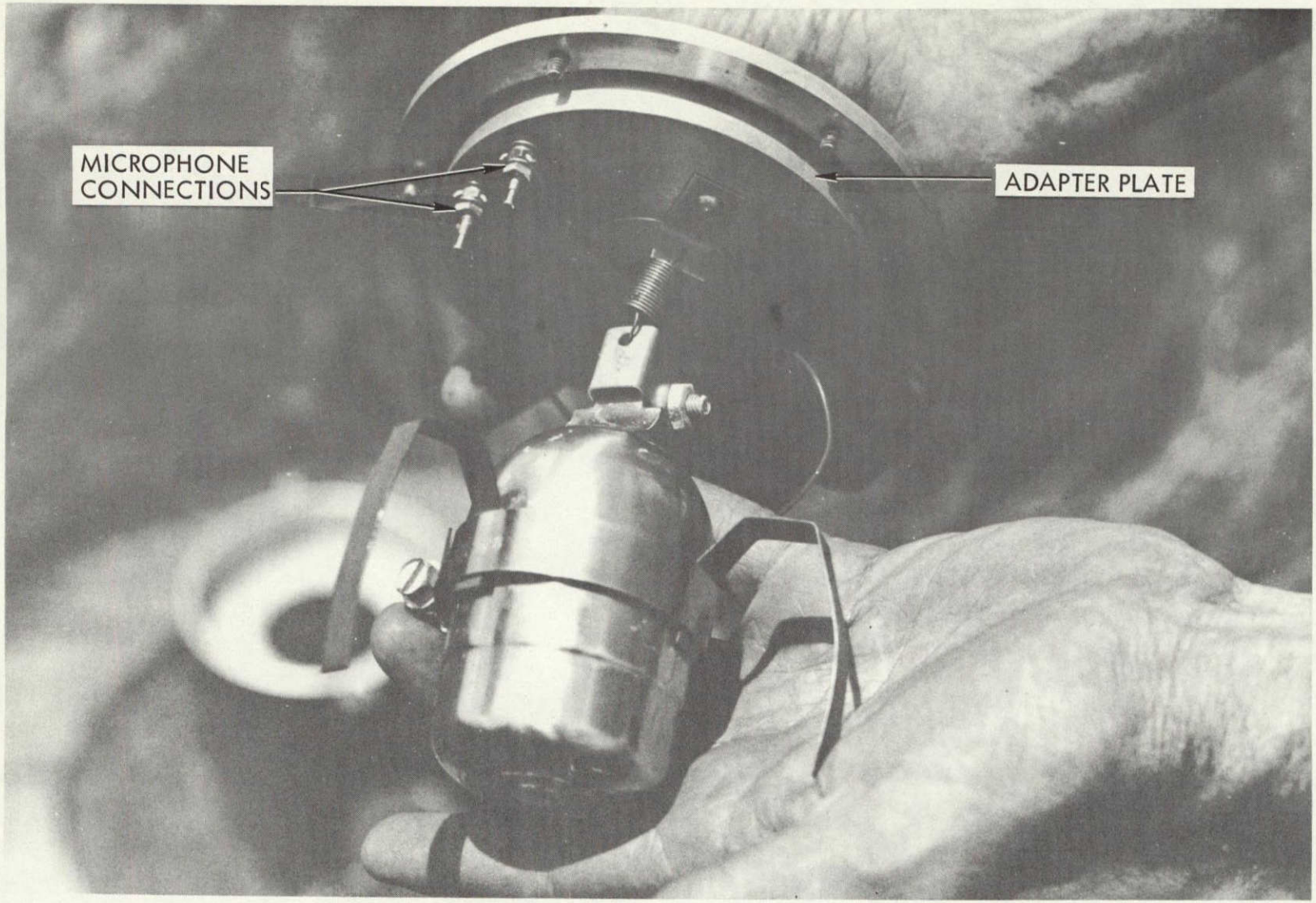

Fig. 9. Microphone adapter connection

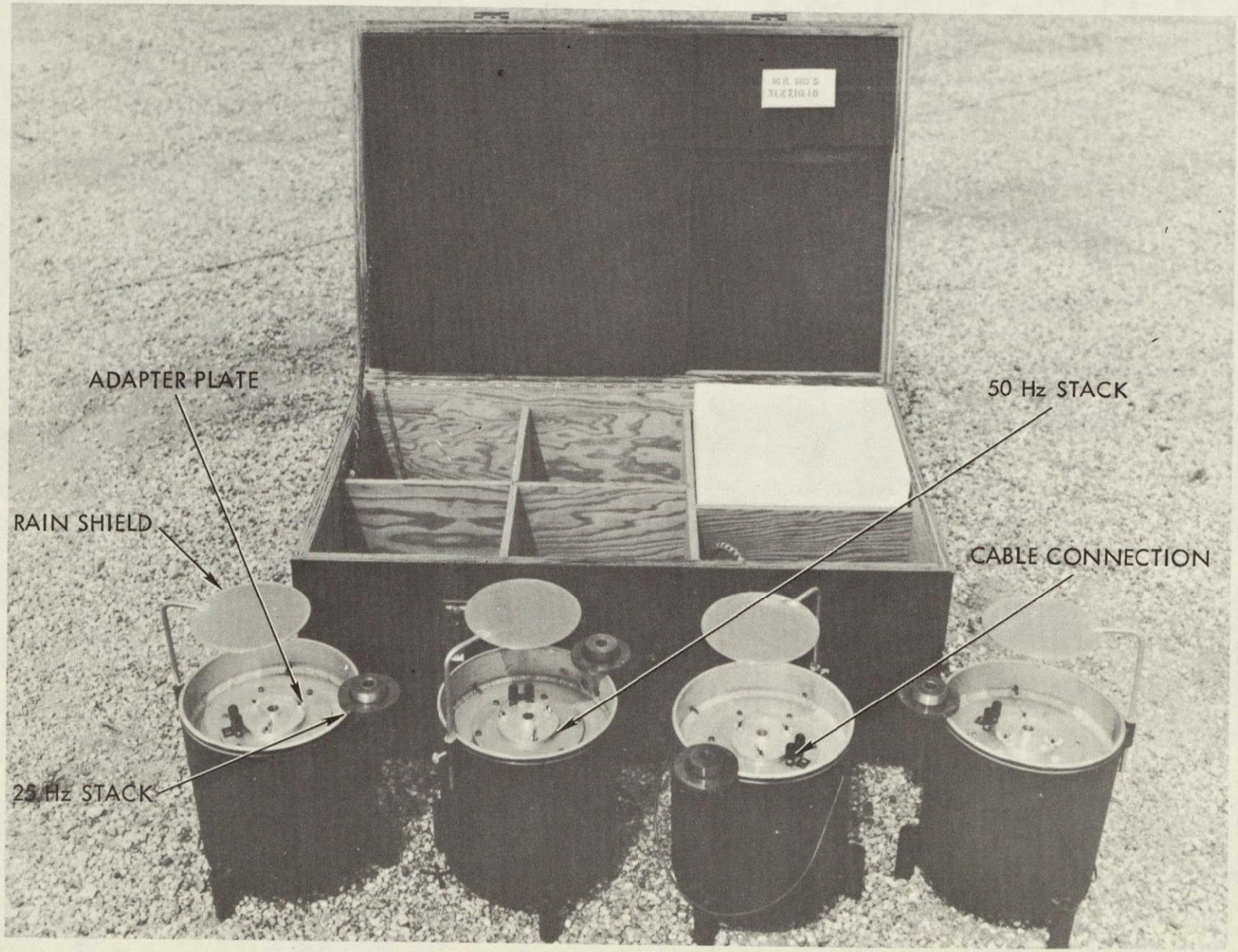

Fig. 10. Microphone installation

D. CAVITY PLACEMENT AND ALIGNMENT

1) Identify each of four survey stakes of the array size to be used at the site.

NOTE

These stakes were driven earlier by the survey party to make the array locations 7.5, 15, 30, or 60 m apart in a square configuration.

2) Place the following equipment at each surveyed site:

Resonant cavity assembly (1 ea)
Bungee cord (1 ea)
Ground stake (3 ea)
Base, wind screen (1 ea)
Wind screen (1 ea)

3) Using the reel dispenser, string one cable from each surveyed site to the center of the array, ensuring that there is a 3-ft slack at the site end. (The site end should have the GR plug connector.)
4) Place the wind screen base (Fig. 11) with eyebolts up, centered approximately around the survey stake of the array to be used.
5) Drive three steel pins through the holes in the base to secure the base to the ground.
6) Place the tripod over the surveyed stake (Fig. 11) and extend the legs so that the top surface is about 3 ft from the ground to facilitate positioning of the resonant cavity and alignment through the eye-piece.
7) Adjust the legs of the tripod, as necessary, to level the alignment tool roughly.
8) Make a fine adjustment on the level of the alignment tool, using the leveling head, and center the bubble on the large base plate.

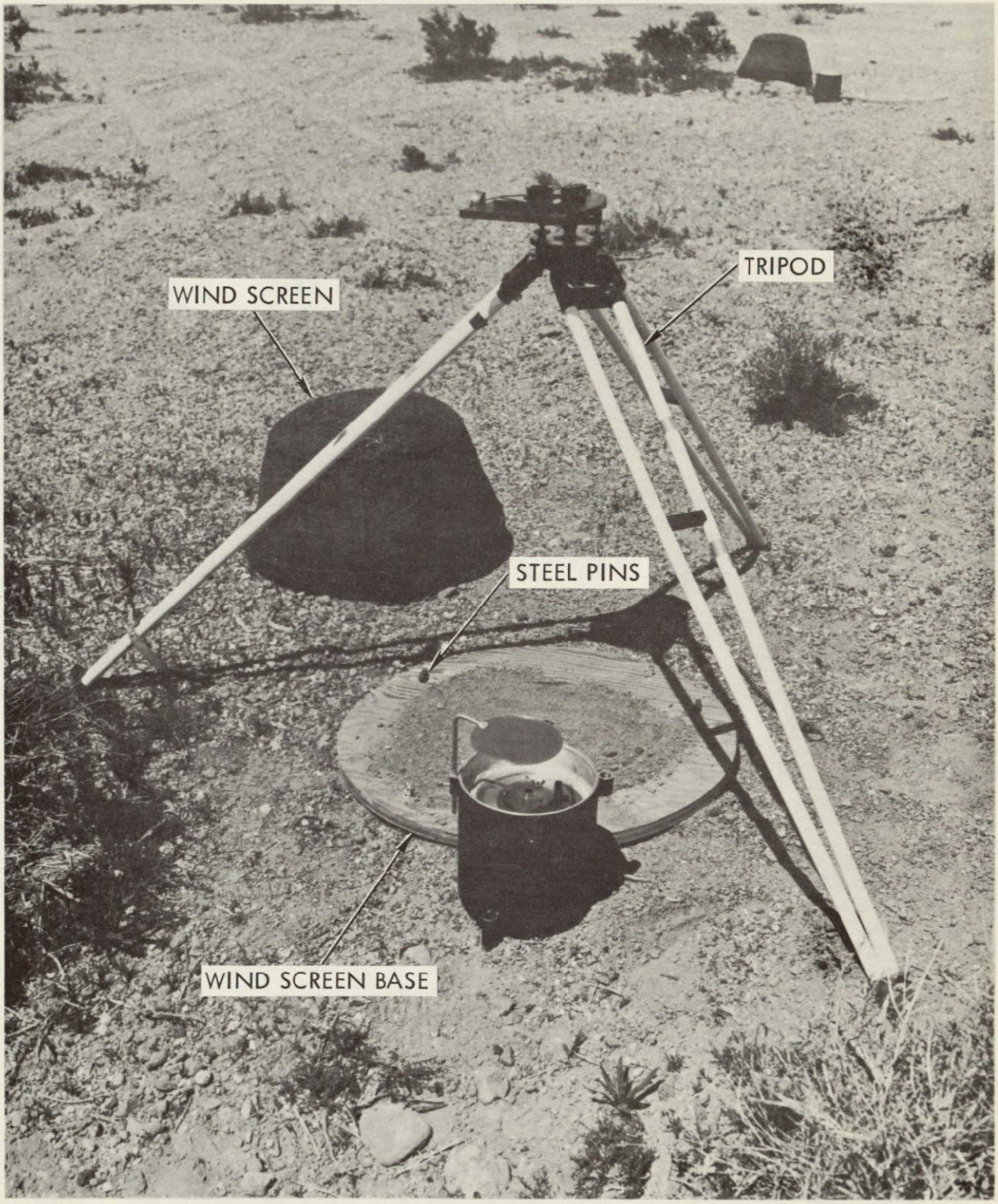

Fig. 11. Wind screen base and tripod

9) Place a siting plate on the base plate of the alignment tool.

10) Make an approximate alignment of the tool with the center of the survey stake.

11) Ensure that the siting plate has the same degree of level as the base plate.

NOTE

If the level of the siting plate is not the same degree as that of the base plate, remove the siting plate and clean its bottom surface and the top surface of the base plate. Replace the siting plate on the base plate to ensure that both plates have the same degree of level, as indicated by their respective bubbles.

12) Move the siting plate so that the center reticle in the siting glass is directly over the nail head on the survey stake (Fig. 12).

13) Position the resonant cavity over the nail head on the stake. (Fig. 13).

14) Insert a GR plug connector in the socket on the adapter plate allowing some slack in the wire to prevent accidental movement of the positioned cavities or to prevent the jacks from being disconnected.

15) Loosen the thumb screw on the side of the resonant cavity and rotate the rain shield to the side to remove any visual obstruction between the siting glass and the stack.

16) Move the resonant cavity, while siting through the eyepiece, until the center of reticle is aligned with the center of the stack.

17) Return the rain shield to its original position over the cavity.

18) Place the wind screen on its base (Fig. 14) between the two exposed eyebolts and secure the bungee cord hook from one eyebolt, over the wind screen, to the opposite eyebolt (this will secure the wind screen, over the resonant cavity jug to the base).

19) Ensure that the position of the resonant cavity is not disturbed. during the installation of the wind screen and the bungee cord.

Fig. 12. Tripod adjustment

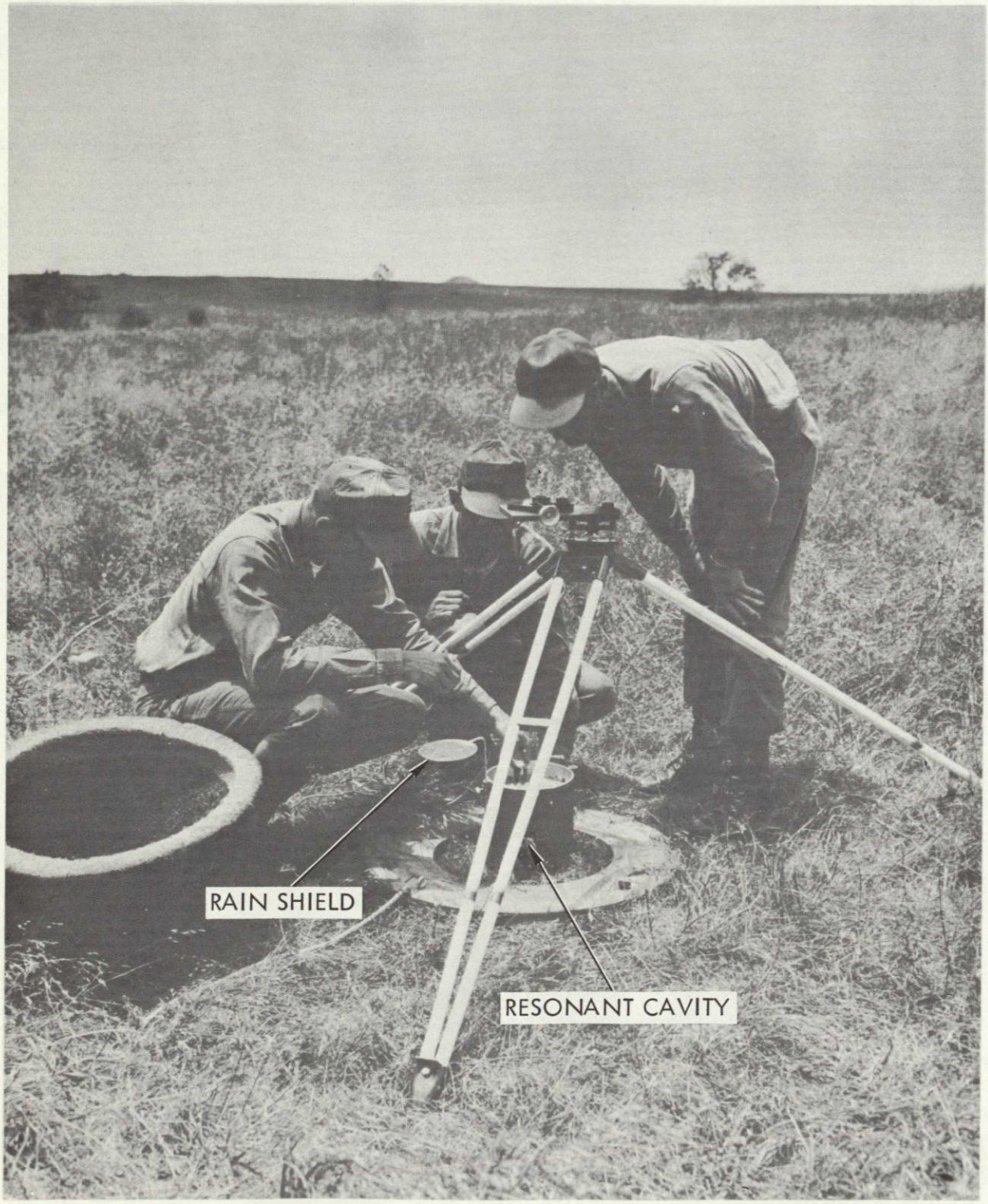

Fig. 13. Resonant cavity installation

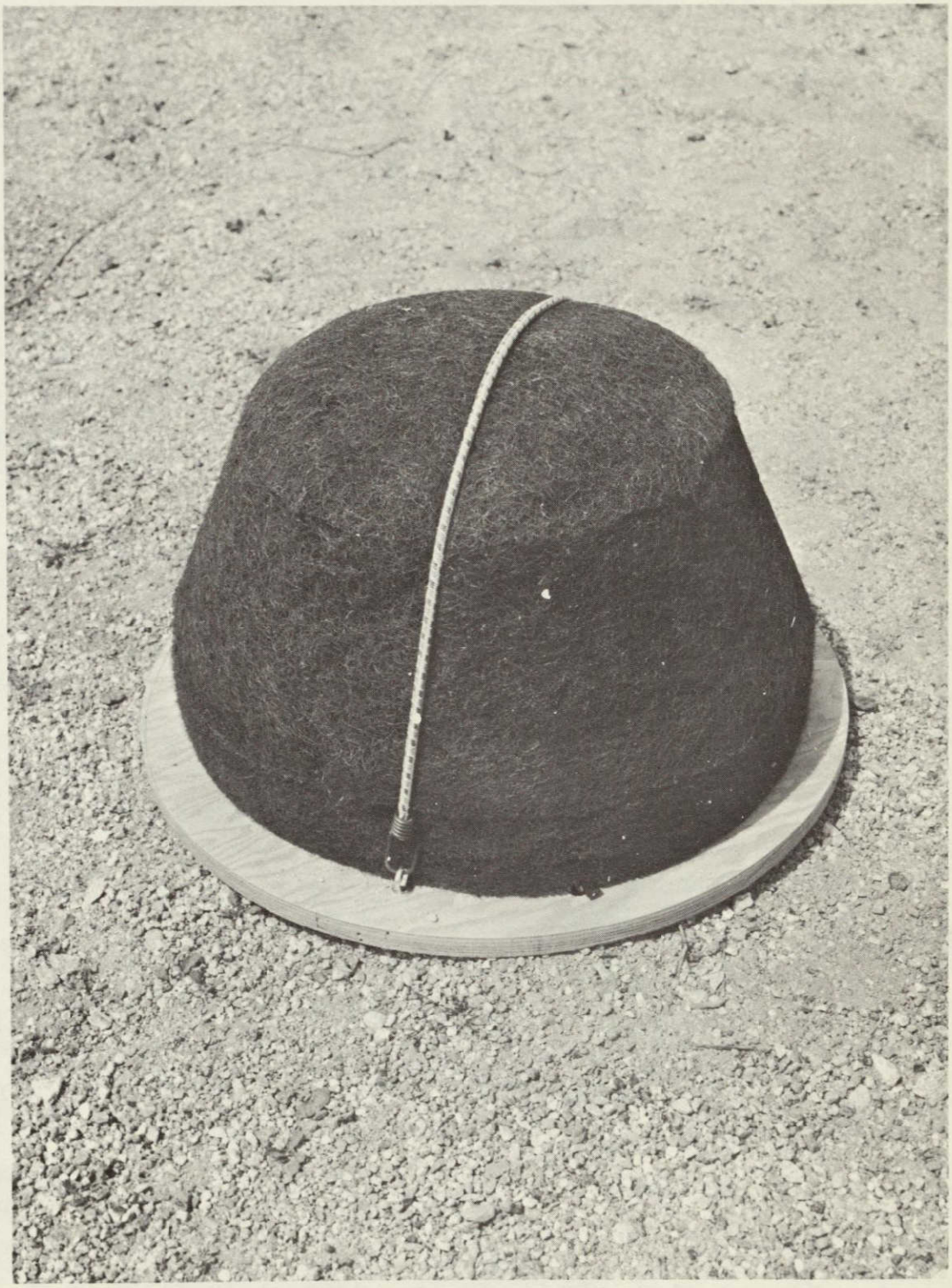

Fig. 14. Wind screen attached to base with bungee cord

E. YAGI ANTENNA ASSEMBLY AND ERECTION

1) Remove the following items from the antenna tube container:

   Support mast 11-ft (1 ea)
   Antenna boom (1 ea)
   Antenna elements (4 ea) with tuning element (1 ea)
   Stabilizers, antenna element, wooden (2 ea)

2) Remove the static charge arrestor cover from the top of the mast and stow it, including the nut and the screw, in the array accessory box.
3) Remove the base plate and the guy wires, with turnbuckles attached, and the three iron stakes, with chain links attached, from the array accessory box.
4) Slip the collar, with the guy wires, over the tip of the mast.
5) Insert the antenna mast into the base socket.
6) Measure the guy wire location from the base of the vertical mast (Fig. 15), and drive an iron stake into the ground. (The mast should be held in a vertical position by another crewman.)
7) Attach the hook of the turnbuckle to a link in the chain (various positions are provided for securing the guy wires).
8) Attach the other guy wires to the stakes in the remaining two positions.
9) Assemble the Yagi antenna.

   a) Place the antenna boom on the ground with the face up so that it shows the color-coded positions for the mandatory attachment of the corresponding color-coded elements.
   b) Assemble the four color-coded antenna elements in the following order, reading from the top: Orange, Blue, White, Red.

NOTE

The insulator block is keyed to accept the color-coded elements.

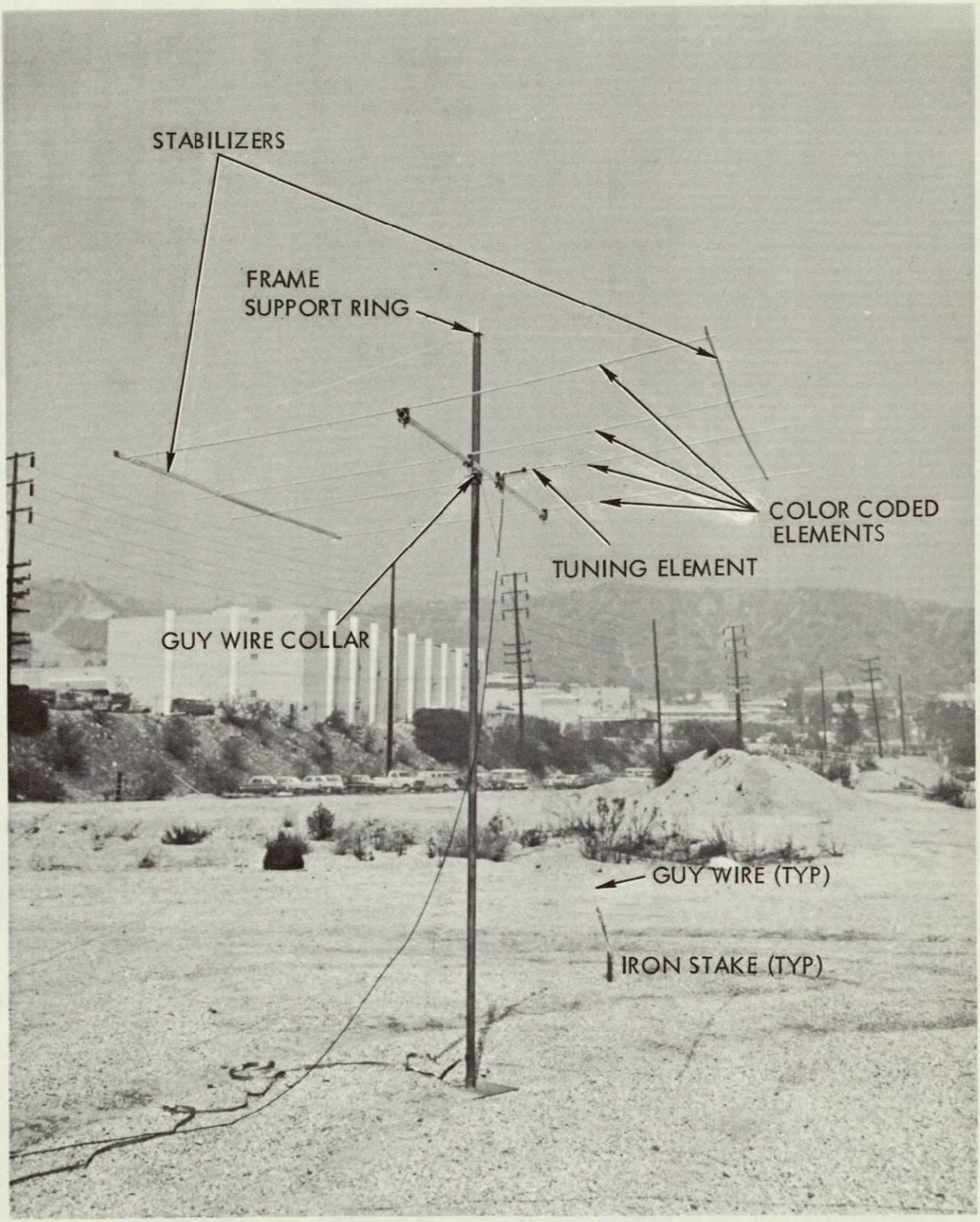

Fig. 15. Yagi antenna and mast

c) Attach the blue and white elements, and then the red and orange elements, to the boom.

d) Insert the tuning element (coded white) at the location identified on the white antenna element, using the screws and nuts provided.

e) Assemble the wooden antenna element stabilizers so that the orange tips are oriented with the orange-coded antenna elements.

9) Attach the Yagi antenna to the antenna mast.

a) Release two guy wires and pitch the antenna mast to the working level while another crewman inserts the tip of the mast through the antenna frame support ring.

b) Install the U-clamp of the antenna boom over the boom resting under the adapter block and tighten the U-clamp with nuts so that the antenna is fastened to the mast.

c) Ensure that the boom is 1 in. above the guy wire collar.

10) Install the coaxial cable with the red wire (conductor) to the tuning element and blue wire (ground) to the boom.

11) Tape the coaxial lead to the antenna mast and return the mast base to an upright position.

12) Replace the guy wires so that the antenna boom is pointing to the receiver antenna.

13) Remove the dust cap from J1 on the RES and install P1 (antenna cable) to J1.

F. FINAL ARRAY ASSEMBLY

1) Remove the 6-ft grounding rod (Fig. 16) from the antenna tube and drive the grounding rod at least 4 ft into the ground with a post driver or a sledge hammer.

2) Remove the 8-ft and 25-ft grounding straps from the accessory box and attach one end of both straps to the top of the grounding rod.

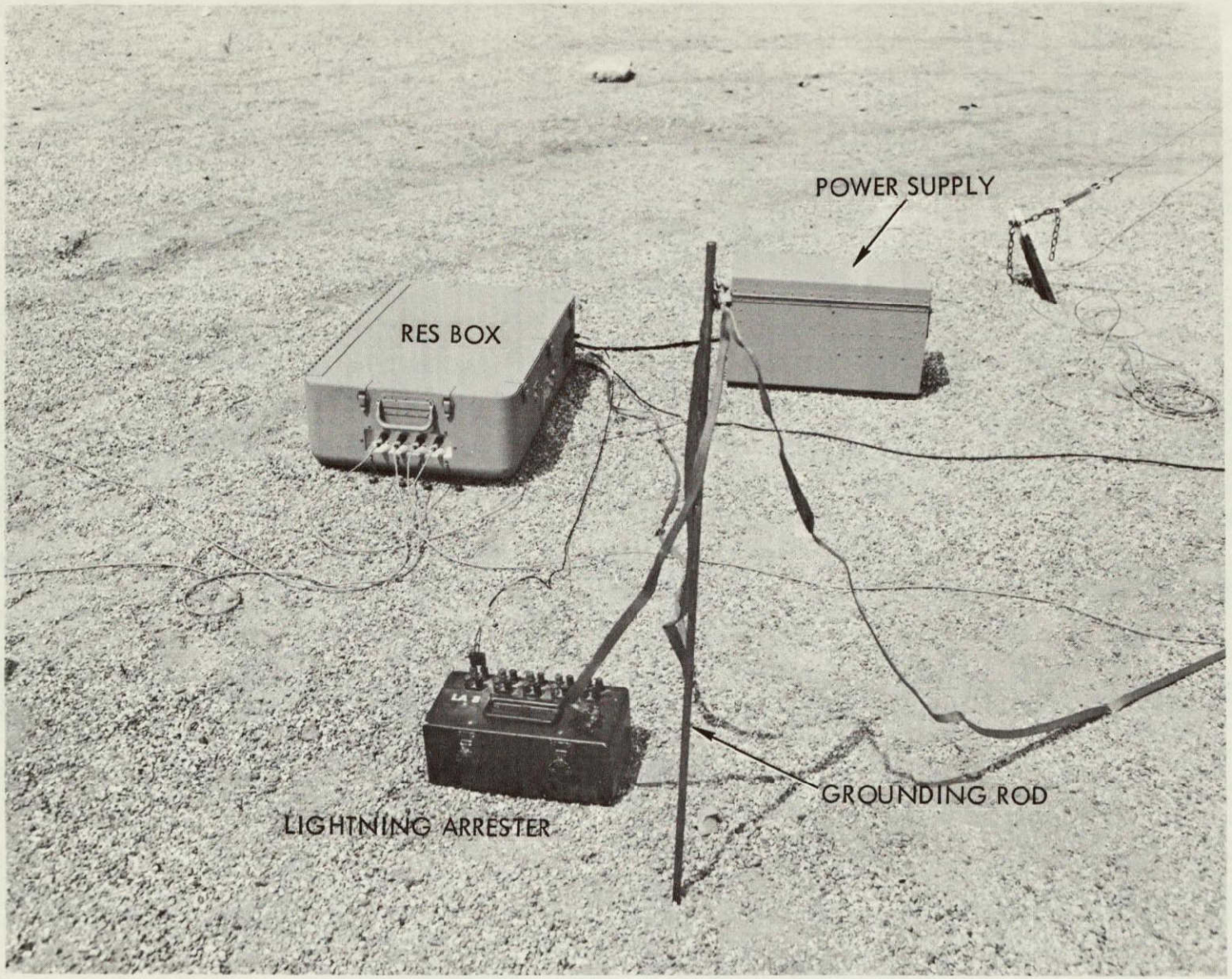

Fig. 16. Arrangement of grounding rod, RES box, power supply and lightning arrestor

3) Attach the opposite end of the 8-ft braid to the RES electronics ground stud.
4) Attach the opposite end of the 25-ft braid to the lug at the base of the antenna support mast.
5) Remove the dust cap from J1 on the RES and install P1 (antenna) cable) to J1.
6) Connect the shielded signal lines from each resonant cavity to the appropriate N-S-E-W jack on the RES.
7) Turn the RES power switches off before installing the power cable from the RES to the power supply.
8) Connect the battery cable from the battery case to the RES.
9) Verify that the RES control switches are in the proper position for the array size.
10) Turn the three power switches on in the end of the RES.
11) Reset the system by pushing the reset switch left, right, and then left again.

G. ARRAY DISMANTLING AND DISASSEMBLY PROCEDURE

Reverse the entire procedure.

PART TWO

OPERATION PROCEDURES

SECTIONS VI THROUGH X

SECTION VI

MANUAL DATA ENTRY

The capability of the AN/TNS-9 set, which is to be used in various applications, requires that many of the program constants and operating conditions be entered manually. These items are placed in the system through the manual data entry panel on the communications operator display (Fig. 17).

A. EQUIPMENT REQUIRED

The Central Data Subsystem (CDS) is the only equipment for which manual entries will be made for data operations.

B. TOOLS REQUIRED

There are no tools required to place different constants and operating conditions in the system.

C. DATA ENTRY

1) Set the Manual Data Entry (MDE) switches for the desired entry in accordance with Table 1.
2) Press the MDE button to enter data.
3) Repeat steps 1 and 2 until all desired entries have been made.
4) Set REPORTS A 00 on the switches and press the MDE button.
5) Verify all data inputs from the Litton printer paper.

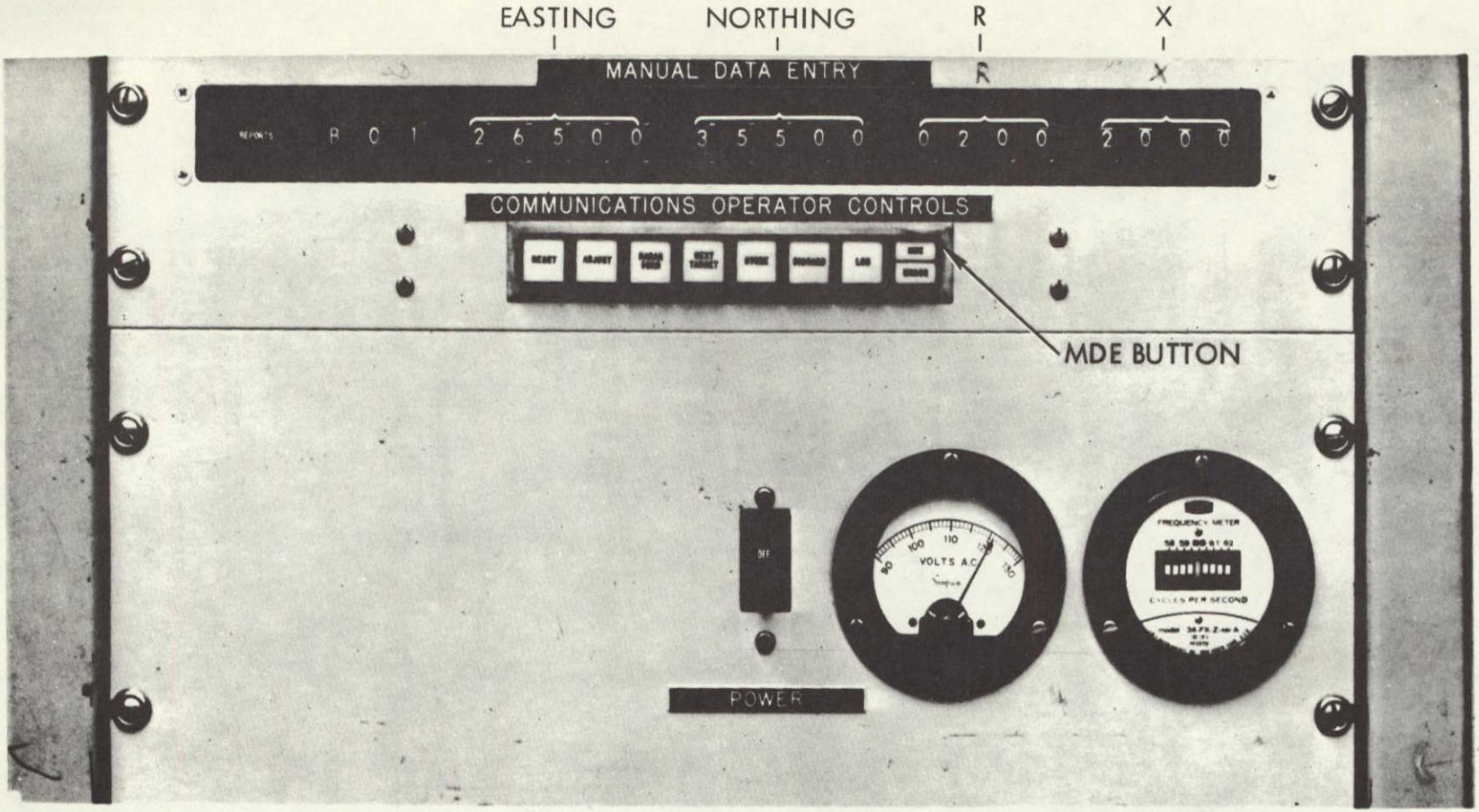

Fig. 17. Manual data entry panel

Table 1. Catalog of manual data entry functions

Reset	S	00	Reinitialize hardware/software system (including automatic reset M 00, Reset R 00, Reset T 00)
	A	00	Reset display priority (rounds) of all targets
	M	0D	Disable (D=0) or enable (D=1) least squares time fit on data
	R	0D	Disable (D=0) or enable (D=1) raw azimuth print mode
	T	0D	Disable (D=0) or enable (D=1) automatic log target print mode
Setup	A	00	Clear all existing array definitions
	A	DD	Define array DD at E, N with look angles (R=AZ) left, (x=AZ) right
	B	00	////////// Clear base definition, all data /////////
	B	01	Define E, N = location of center of base, R=TOVB, X=CHAL where TOVB = Time over the base in seconds*10 CHAL = Characteristic length in meters
	B	02	Define E=AOIR (area of interest radius in meters)
	B	03	Calculate the base perimeter array to array with look angles
	R	00	Clear all existing radar definitions
	R	DD	Define radar DD at E, N
Program	A	00	Input E, N, R, X=LQRT DQRT QALT RNDT where LQRT = Limbo queue retention time in minutes*10 DQRT = Discard queue retention time in minutes*10 QALT = Quality factor (number of rays needed for target) RNDT = Rounds transfer threshold
	B	00	Input E, N, R, X=TGAT ZTOL SRAZ ADAR where TGAT = Time gate in milliseconds ZTOL = Azimuth tolerance in mils SRAZ = System resolution angle in mils ADAR = Adjust area radius in meters
Check	C	00	Generate and process a check point for MDE E, N
	M	00	Initiate memory test procedure
	O	0D	Output unit diagnostic (D=0=printer, D=1=display)
Reports	A	00	Generate all reports
	B	00	Base definition
	C	00	Program constants
	H	00	Tactical areas currently defined
	O	00	Operational target/event disposition
	S	00	Array statistics summary
	T	00	All targets (communications and sentinel queues)
Operate	M	00	New meteorological data E=WVEL N=WDAZ R=FHAR where WVEL = Wind velocity in knots WDAZ = Wind azimuth in mils FAHR = Temperature in degrees F

Table 1 (Contd)

	O	DD	Input observation target DD at E, N
	T	00	Reset calendar time E=month, N=day, R=hour, X=minute
			Define circular (X=0) or rectangular (X=height) tactical area No. DD
			(if circular then R=radius)
			(if rectangular then E, N=southwest corner of rectangle with R=width=easting, X=height=northing)
	F	DD	Friendly
	H	DD	Hostile
	N	DD	Neutral
Call	Z	DD	Call up target (Z = H, N, O, S) to comm display
Remove	Z	DD	Delete tactical area (Z = F, H, N) from system

Additional manual data entry functions

Reset	C	0D	E, N change memory cell E to octal DNNNNN
Check	A	00	Display memory cell (E=address) on sentinel display
Check	H	00	Display MDE data (E=Octal, N=decimal)
Report	M	99	Memory dump location E through N, R=Mode (O=Octal, 1=Decimal)
Operate	R	00	Enter expedience binary loader

NOTE: If all switches are not specified, only those listed must be set.

SECTION VII

INITIALIZATION PROCEDURE

The initial setup of the program parameters at a specific base location should be accomplished with the following procedure.

A. EQUIPMENT REQUIRED

The Central Data Subsystem is the only equipment required for the initialization procedure.

B. TOOLS REQUIRED

No tools are required to establish initial program parameters.

C. DETAILED PROCEDURE

After each entry has been made, the MDE button is to be depressed (Fig. 17).

1) Enter Setup B 00 on the MDE panel. (Clear base definition; all data)
2) Enter Setup B 01 Define E, N=location of center of base, R=TOVB, X=CHAL, where TOVB = Time over the base in seconds*10
   CHAL = Characteristic length in meters
3) Enter Setup B 02 Define E* AOIR (area of interest radius in meters)
4) Enter Setup A DD Define array DD at E, N with look angles R=AZ, Left, X=AZ, Right
5) Enter Setup R DD Define radar DD at E, N (if required)
6) Enter Setup B 03 calculate the base perimeter array to array with look angles

7) Enter Program A 00 input E, N, R, X = LQRT DQRT QALT RNDT

where LQRT = Limbo queue retention time in minutes*10
DQRT = Discard queue retention time in minutes*10
QALT = Quality factor (number of rays needed for target)
RNDT = Rounds transfer threshold

8) Enter Program B 00 input E, N, R, X=TGAT ZTOL SRAZ ADAR

where TGAT = Time gate in milliseconds
ZTOL = Azimuth tolerance in mils
SRAZ = System resolution angle in mils
ADAR = Adjust area radius in meters

9) Enter Operate M 00 New meteorological data E=WVEL N=WDAZ R=FHAR

where WVEL = Wind velocity in knots
WDAZ = Wind azimuth in mils
FAHR = Temperature in degrees F

10) Enter Operate T 00 Reset calendar time E=month, N=day, R=hour, X=minute

11) Enter Reset S 00 Reinitialize hardware/software system (including automatic reset M 00, reset R 00, reset T 00)

12) Enter Reset R 0D Disable (D=0) or enable (D=1) raw azimuth print mode

13) Enter Reset T 0D Disable (D=0) or enable (D=1) automatic log target print mode

14) Enter Reports A 00 Generate all reports

15) Enter Check M 00 Initiate memory test procedure

16) Enter Check O 0D Output unit diagnostic, (D=0=printer, D=1=display)

17) Enter Check C 00 Generate and process a checkpoint for MDE E, N

SECTION VIII

BOOTSTRAP LOADING PROCEDURE

The Bootstrap Loading Procedure should be used when the contents of the memory are not known or are in doubt. This is a procedure to load a program into a core that will be able to load the program called "Expedience Loader." This, in turn, will be able to load the system program.

A. EQUIPMENT REQUIRED

The CDS is the only equipment required for the Bootstrap Loading procedure.

B. TOOLS REQUIRED

No tools are required to use the Bootstrap Loading Procedure.

C. DETAILED PROCEDURE

All referenced switches are on the computer control panel (Fig. 18).

1) Load the paper tape reader with the expedience loader program so that the first binary frame is directly under the read station.
2) Press the system reset switch.
3) Turn off (down) all panel switches.
4) Turn on (up) the repeat switch.
5) Turn on the U switch.
6) Press the reset switch.
7) Set 0 101 100 000 000 000 in the computer console light switches.
8) Turn off the U switch.
9) Turn on the P switch.
10) Press the reset switch.
11) Set 0 001 111 111 101 110 in the console light switches.

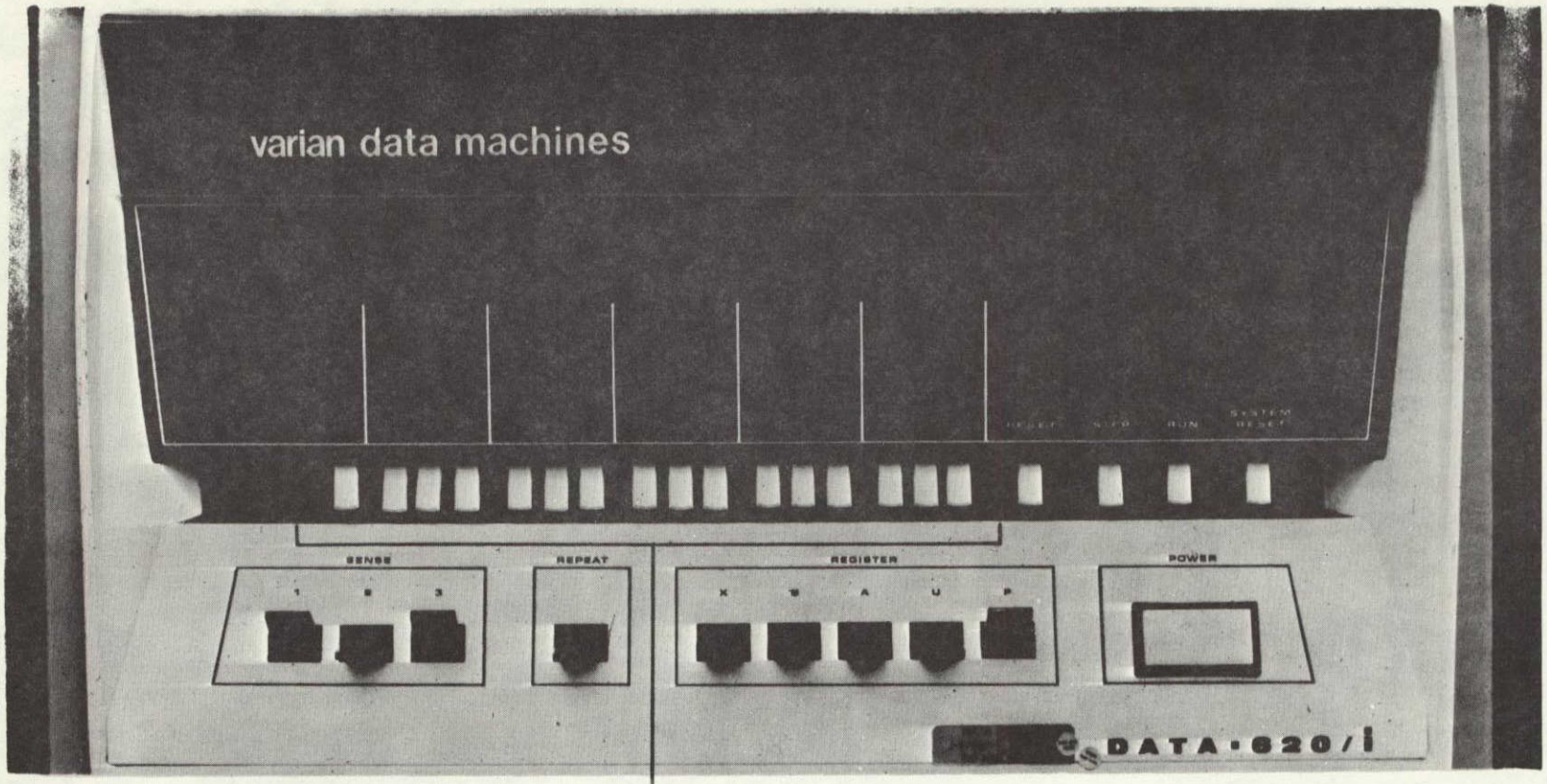

Fig. 18. Computer control console

12) Turn off the P switch.

13) Turn on the A switch.

14) Press the reset switch.

15) Enter an instruction (first one first) in the console light switches from the following list of instructions:

A	1	000	010	110	011	111	102637
B	0	000	100	000	001	001	004011
C	0	000	100	000	100	001	004041
D	0	000	100	100	100	110	004446
E	0	000	001	000	010	000	001020
F	0	001	111	111	111	010	017772
G	0	101	101	000	000	000	055000
H	0	000	001	000	001	000	001010
I	0	001	111	110	000	000	017600
J	0	000	101	001	100	100	005144
K	0	000	101	001	000	001	005101
L	1	000	000	101	011	111	100537
M	1	000	001	101	011	111	101537
N	0	001	111	111	101	110	017756
O	0	000	001	000	000	000	001000
P	0	001	111	111	111	010	017772

16) Press the step switch.

17) Repeat steps 14, 15, and 16 for each consecutive instruction in the list when the list is exhausted, go on to step 18.

18) Turn off switch A.

19) Turn on switch 1 if the console lights = 0 001 111 111 111 110, then the load is probably ok. If not, start over.

20) Press the reset switch.

21) Enter 0 001 111 111 111 000 into the switches.

22) Turn off switch U.

23) Turn on switch A.

24) Press the reset switch.

25) Turn off A.

26) Turn on B.

27) Press reset.

28) Turn off B.

29) Turn on X.

30) Press reset.

31) Enter 0 001 111 110 000 000 in the console light switches.

32) Turn off X.

33) Press the system reset switch.

34) Press the run switch. The paper tape should now read completely in.

NOTE

Some common causes of failure are:

1) A mistake was made in loading the bootstrap.

2) The tape was not the first binary frame in the reader.

SECTION IX

SYSTEM PROGRAM LOADING PROCEDURE

This procedure is to be used for loading the system program into the computer.

A. EQUIPMENT REQUIRED

The CDS is the only equipment required to load the system program.

B. TOOLS REQUIRED

No tools are required for the system loading procedure.

C. DETAILED PROCEDURE

All switches called out are on the computer control panel.

1) Load the bootstrap program, if necessary. (See bootstrap loader instructions.)
2) Press the system reset switch.
3) Turn off (down) all panel switches.
4) Turn on the P switch.
5) Press the reset switch.
6) Set 0 001 111 111 000 000 (17700 octal) in the register switches.
7) Turn off the P switch.
8) Turn on the U switch.
9) Press the reset switch.
10) Turn off the U switch.
11) Load the paper tape reader (see paper tape reader loading instructions).

12) Press the console run switch.

NOTE

The tape should now read in to the end. If it does, go on to the next step. If it does not, back the paper tape so that the read head is anywhere on the other side of the last set of all holes punched "read." Press the "run" control. If the machine stops again in the same place, the tape is probably damaged; use another tape.

13) The tape is now completely in. Turn on switch U.

14) The console lights should be 0 000 000 100 000 001. If not; start over. If ok, then go on.

15) Press the reset switch.

16) Turn off the U switch.

17) Turn on the P switch.

18) Press the reset switch.

19) Press the system reset switch.

20) Press the run switch. The system program is now active.

SECTION X

THREADING AND OPERATING PAPER TAPE READERS

The procedure for loading and operating the photoelectric tape reader-reeler is presented below.

A. EQUIPMENT REQUIRED

The CDS is the only equipment required.

B. TOOLS REQUIRED

No tools are required for threading and operating the paper tape readers.

C. OPERATING CONTROLS

The tape reader has the following controls (Fig. 19):

1) Switch. This switch has two positions marked FWD and REV. The FWD position selects a forward (left to right) reading operation. The REV position selects a reverse (right to left) reading operation.
2) Right dancer arm. A dancer arm is associated with the right tape reel. An internal spring drives the arm toward the outside where it rests against a stop. The right dancer arm always controls the right reel drive.
3) Left dancer arm. A dancer arm is associated with the left tape reel. Operation is similar to the right dancer arm described in 2) above. The left dancer arm always controls the left reel drive.

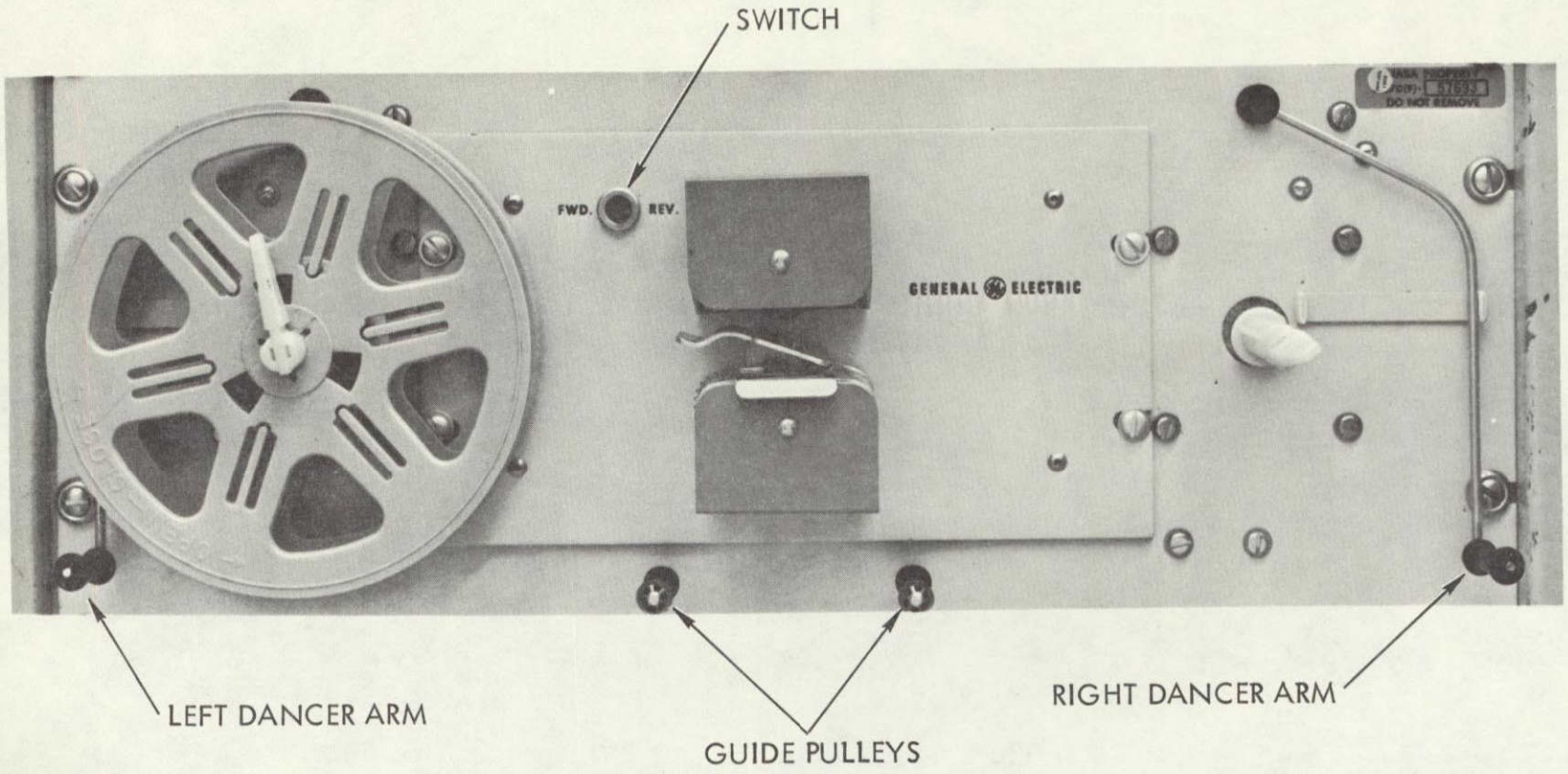

Fig. 19. Paper tape reader

D. TAPE LOADING

Tape loading consists of mounting a full reel on one drive hub, mounting an empty reel on the other, and threading tape from one to the other. For all normal operations, the manner in which the reel was loaded with tape determines which hub the full reel should occupy. Loading consists of three steps -- checking tape, mounting reels, and threading.

1) Tape check

   a) Examine a full reel of tape before mounting to determine which side of the reel is associated with the guide edge of the tape on the reel. The guide edge is always the edge closest to the sprocket track in normal operation.

   b) Hold the reel with the guide edge side away and with the outer tape end feeding from the top of the reel. If the tape feeds to the left, the reel must be mounted on the right hub. If tape feeds to the right, the reel must be mounted on the left hub. If this is not in agreement with the job instructions, check to be sure. For example, a tape reel to be read in a forward direction may require to be rewound before reading.

2) Reel mounting.

   a) After a tape check, select the hub for mounting and open the latch, pulling it forward to allow the reel to be slipped onto the hub. Be sure the guide edge side of the reel is mounted toward the reeler panel.

   b) Three blades, or splines, on the hub are designed to mate with slots on the reel to ensure positive drive. Rotate the reel if necessary so that the splines engage the slots. When this is done, it will be possible to close the latch. This locks the reel firmly in place and completes the mounting procedure.

   c) Check to be sure that the outer turn of tape feeds off the top of the reel toward the inside. Load an empty reel on the remaining hub.

3) Threading

CAUTION

Turn the power off before threading any reader-reeler combination. When the power is on, any inward movement of the dancer arms will start the associated reel.

a) With power off and the switch in FWD, start the threading operation by unwinding about three feet of tape from the supply reel. Thread the tape.

b) To thread the reader, lift the upper tape guide and place the tape in the lower guide. Make sure the sprocket holes engage the teeth on the sprocket drive wheel. Close the upper tape guide. Be sure that tape feeds into the take-up reel at the top inside. Leave enough slack in the threaded tape so that the dancer arms are not pulled away from their stops. Turn power on and select the correct operating direction. Complete the threading operation by carefully moving the take-up reel so as to bring its dancer arm away from the broken tape zone. At this point, threading is complete.

E. SELF-THREADING REELS

General Electric reels have self-threading fingers built into the reel flanges. When a tape end is fed into a moving reel, these fingers trap the tape edges and press the tape against the reel hub with enough force to ensure reliable threading.

F. MALFUNCTION

The reeler controls protect the system against errors caused by tape transport problems.

G. BROKEN TAPE

Broken tape will release both dancer arms to the broken tape zone. This cuts off power to both reader and reeler.

H. TAUT TAPE

Most tape transport malfunctions, other than broken tape, will cause one or both dancer arms to exceed their normal range and reach the taut-tape position. When this condition occurs, the interlocks prevent the reader from advancing the tape.

PART THREE

MAINTENANCE PROCEDURES

SECTIONS XI AND XII

SECTION XI

ARRAY PRETEST INSPECTION

The following procedure is to be used for checkout of the array after installation. It should also be used when the configuration is changed or when a mechanical defect is suspected.

A. EQUIPMENT REQUIRED

All array equipment must be in a deployed configuration and ready for operation.

B. TOOLS REQUIRED

The following tools are required to support the inspection procedures:

Wrench, crescent, 8-in. (1)
Screwdriver, regular tip (1)
Screwdriver, fine tip (1)
Pliers, visegrip (1)

C. DETAILED PROCEDURE

1) RES Electronics

a) Microphone input connectors

(1) Proper sequence (North-North; East-East; etc) ☐
(2) Connectors fully on and locked ☐

b) Test access connector on and locked ☐

c) Land-line connector on and locked ☐

d) Antenna connector

(1) Bulkhead feedthrough tight ☐

(2) Antenna coax connector on and tight ☐

e) Power connector on and locked ☐

f) Chassis ground bolt

(1) Ground bolt tight to chassis ☐

(2) Ground strap on and tight ☐

g) Array size selector switches set for the proper array spacing

Array size_____

h) AGC clock time set to _____seconds

i) RES lid closed and latched ☐

j) Power switches on ☐

k) System reset (left-right-left) ☐

2) Antenna

a) Tuning stub set properly on paint mark ☐

b) Tuning stub to active element clamp in proper position and tight on both ends ☐

c) Coax cable connections tight at the antenna (center conductor to tuning stub) ☐

d) Antenna pointing to sound central ☐

e) Antenna ground strap on mast and tight ☐

3) Battery

a) Battery voltages correct _____Vdc
_____Vdc
_____Vdc

b) Battery cable on and connector locked ☐

4) Ground rod

a) Tight in ground ☐

b) Ground straps on and ground lug tight ☐

5) Microphone cables

a) Inspected (free of breaks; cuts in insulation and shielding) ☐

b) Impedance (approximately 17KΩ) _____Ω

6) Microphone

a) Connector on and tight ☐

b) Wing nuts tight ☐

c) Wind screen on and secured ☐

SECTION XII

ARRAY TROUBLESHOOTING PROCEDURE

The array troubleshooting procedure is to be used for field checkout or troubleshooting when sound azimuths are not being received.

A. EQUIPMENT REQUIRED

All equipment required for array deployment must be installed and the SCS must be operational.

B. TOOLS AND ACCESSORIES REQUIRED

The following items of equipment are required for troubleshooting in addition to the handtools needed for array pretest inspection.

Array radio, portable (1 ea)
Logic test box, digital (1 ea)

C. DETAILED PROCEDURE

1) Perform the array pretest inspection outlined in Section XI (Fig. 20). If deficiencies are found, perform step 2; if not, begin at step 3.
2) Provide a simulated sound input and check the data input at the SCS. If the data input is correct, no further checkout is necessary; if not correct, proceed to step 3.
3) Remove the transmitter from the RES electronics case and insert the transmitter battery in the bottom of the transmitter (ensure that the 1785 tone line remains connected to the transmitter).
4) Key the transmitter on the voice position and verify tone receiver at the SCS. If a tone is received, replace the transmitter and battery in the RES electronics package and proceed; if a tone is not received, replace the transmitter battery and repeat this step. If a tone is still not received, replace the transmitter. If a problem is found, perform step 2.

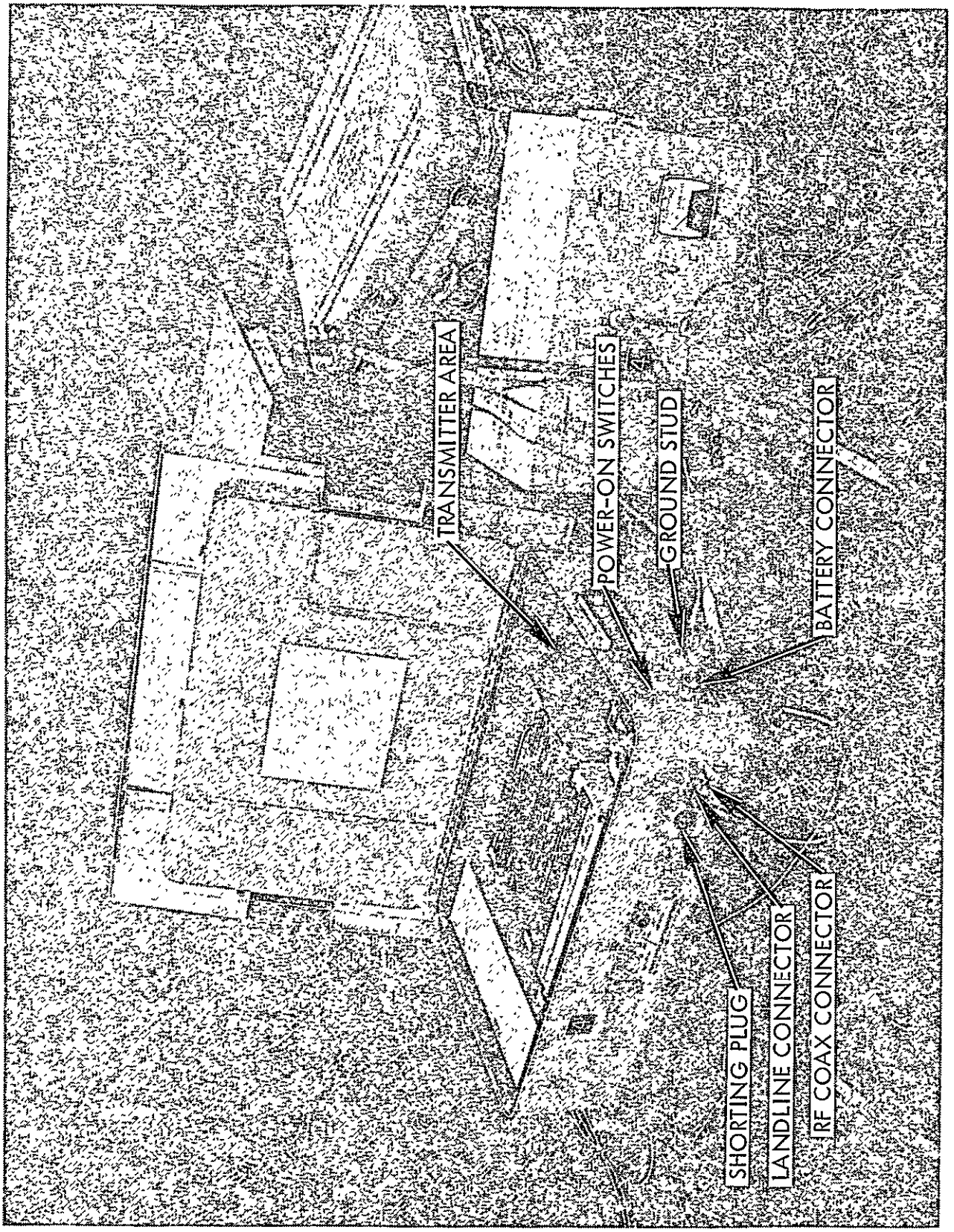

Fig. 20. Electronics for RES

5) Remove the shorting plug and connect the digital test box to the test access connector. Perform a system reset.

6) Transmit encoder test messages. If they are not received, return the RES electronics for detail encoder checkout; if messages are received, proceed with step 7.

7) Transmit dual data mode digital logic test messages from the test box and verify receipt at SCS. If received, proceed with step 8; if not received, return to the RES electronics for detail digital check-out.

8) Put the digital test box in the PASS ALL MESSAGE mode.

9) Tap on the horsehair cover at the North microphone. Verify receipt of a North overrun message at the SCS. If received, repeat this step for the other microphones; if not received, proceed with step 10.

10) Verify connections and array cable continuity. Replace or repair broken connections, cables, or microphones.

11) Remove the test box and reconnect the shorting plug. Perform a system reset.

12) Provide a simulated sound input to the array and verify receipt at the SCS.

APPENDIX A

DETAILED EQUIPMENT LIST

A. ARRAY EQUIPMENT

Item Number	Name of Item	Number Required
1	Box, array support hardware	8
	Cables, resonant chambers to RES (4 ea)	
	Straps, ground, 36-in. (2 ea)	
	Strap, ground, 10-ft (1 ea)	
	Strap, ground, 25-ft (1 ea)	
	Stakes, guy wire, steel (3 ea)	
	Wire, guy, antenna (1 ea)	
	Base, antenna (1 ea)	
	Cable, antenna, coaxial (1 ea)	
	Arrestor, lightning (1 ea)	
	Cable, battery pack (1 ea)	
	Cable, land line (1 ea)	
	Antenna support package (1 ea)	
2	Box, array antenna hardware	8
	Antenna, Yagi (1 ea)	
	Mast, antenna, 10-ft (1 ea)	
	Rod, grounding, 6-ft (1 ea)	
3	Box, array microphones	8
	Resonators, Helmholtz with handles (4 ea)	
	Stacks, 50 Hz (4 ea)	
	Stacks, 25 Hz (4 ea)	
	Microphones with adapter plates (4 ea)	
	Screens, ring (4 ea)	
	Cords, tie-down, bungee (4 ea)	
	Stakes, steel (12 ea)	

Item Number	Name of Item	Number Required
4	Base, plywood, for microphone cylinders	32
5	Cover, horsehair (hat)	32
6	Pack, battery	8
	Batteries, 6-V small (4 ea)	
	Battery, 6-V large (1 ea)	
7	Assembly, electronics, RES	8

B. SOUND CENTRAL EQUIPMENT

Item Number	Name of Item	Number Required
1	Antenna, telescopic, 50-ft, with guy wire assembly	1
2	Baseplate, antenna	1
3	Pipe, antenna, 2-in., 20 ft length	1
4	Data hub, antenna	1
5	Box, antenna accessories	1
	Amplifier (1 ea)	
	Cable, coaxial, 10-ft (1 ea)	
	Cable, coaxial, 100-ft (1 ea)	
	Cable, amplifier power, 100-ft (1 ea)	
	Strap, ground, 125-ft (1 ea)	
	Arrestor, static charge, pointed (1 ea)	
	Stakes, baseplate, 14-in. (3 ea)	
6	Box, wind instrument hardware	1
	Mast section with base, 6-ft (1 ea)	
	Mast section, 6-ft (1 ea)	
	Stakes (3 ea)	
	Wires, guy with turnbuckles (3 ea)	
7	Transmitter, aerovane wind direction and velocity with adapter head	1
8	Propeller, wind transmitter	1
9	Indicator, temperature and wind, with cable	1

Item Number	Name of Item	Number Required
10	Sensor, temperature, with cable	1
11	500-ft wind instrument cable	1
12	Anchors, screw, antenna, 50-ft	3
13	Shackles, antenna, 15-ft	3
14	Hooks, grab, antenna, 50-ft	3
15	Chains, antenna, 50-ft	3
16	Panel, indicator, wind velocity and direction	1
17	Machine, TTY	1
18	Rack, CDS, 3-bay	1
	Computer, 620 I (1 ea)	
	Cores, computer (2 ea)	
	Printer, Datalog, MC 4600 (1 ea)	
	Reader, GE tape (1 ea)	
	Panel, communications display (1 ea)	
	Panel, manual data entry (1 ea)	
	Panel, AC power control (1 ea)	
	Panel, AC power distribution (1 ea)	
	Panel, TM data translator (1 ea)	
	Transformer, power isolation (1 ea)	
	Panel, buffer (1 ea)	
	Panel, sentinel display (1 ea)	
	Power supply, computer (1 ea)	
	Power supply, 5.25-V (1 ea)	
	Power supply, 7.25-V (2 ea)	
19	Rack, Receiver/Decoder	1
	Oscilloscope, type RM 561A (1 ea)	
	Amplifier, type 3A1 (1 ea)	
	Amplifier, type 3B1 (1 ea)	
	Printer, Franklin (1 ea)	
	Unit, switching, decoder (1 ea)	
	Unit, decoder (1 ea)	

Item Number	Name of Item	Number Required
19	Simulator and register (1 ea) Power supply, decoder (1 ea) Power supply, preamplifier (1 ea) Assembly, multicoupler/receiver (1 ea)	
20	Straps, ground, 4-ft	2
21	Rods, ground, 6-ft	2
22	Arrestors, lightning	2
23	Cable, trailer to lightning arrestor	1
24	Strap, ground, 6-ft	1

APPENDIX B

DETAILED DRAWING LIST

The detailed drawings prepared for the AN/TNS-9 prototype system are shown on JPL Drawing No. 10027408 and on Fig. 21.

APPENDIX C

TOOLS AND SUPPORT EQUIPMENT

The tools and support equipment listed below are required for installation and checkout of the AN/TNS-9 Sound Locating Set. These items are not provided as part of the set.

A. TOOLS

Wrench, crescent 8-in. (1 ea)
Screwdriver, 6-in., regular tip (1 ea)
Screwdriver, 6-in., fine tip (1 ea)
Hammer, sledge, 4-lb (1 ea)
Hammer, sledge, 10-lb (1 ea)
Set, wrench, Allen head (1 ea)
Shovel (1 ea)

B. SUPPORT EQUIPMENT

Chargers, battery
Radios, portable, two-way
Test box, digital
Multimeter
Locating head with tripod
Iron, soldering
Extinguisher, fire
Hydrometers

C. BASE SUPPORT REQUIREMENTS

Housing, Sound Central (1 ea)
Air conditioning system, Sound Central (1 ea)
Power system, Sound Central, with cables (1 ea)
Land lines (1 set)

APPENDIX D

SPARES AND EXPENDABLES

To maintain a continuous operating capability, the following spares and expendable items are required:

1) Array system, complete (1 ea)
2) Analog subsystems (2 ea)
3) Digital subsystems (2 ea)
4) Transmitters, different frequencies (2 ea)
5) Batteries, spare (5 ea)
6) Batteries, transmitters, spare (5 sets)
7) Tape, Litton printer (10 rolls)
8) Receivers, spare (2 ea)
9) Cables, RES-to-microphone, spare (8 ea)
10) Paper, Franklin printer (1 case)
11) Paper, TTY paper (1 case)
12) Hardware, assorted, expendable

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