USAELRDL Technical Report 2368

# SLOTTED CYLINDER ANTENNAS FOR RADIOSONDE SET AN/DMQ-6

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Elza R. Farley

September 1963

**UNITED STATES ARMY**

**ELECTRONICS RESEARCH AND DEVELOPMENT LABORATORY**

**FORT MONMOUTH, N.J.**

U. S. ARMY ELECTRONICS RESEARCH AND DEVELOPMENT LABORATORY
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September 1963

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ABSTRACT

Rocket-borne Radiosonde Set AN/DMQ-6, adapted from a balloon-borne equipment to gather the high-altitude wind and temperature data needed for missile design and evaluation, requires a compact, omnidirectional antenna with good axial coverage to permit tracking of the rocket nose cone on descent as well as ascent. A helical slotted cylinder antenna, compact enough to fit into the nose cone of the ARCAS rocket and with operation in the 1660 mc to 1700 mc frequency range, was developed to meet this requirement. The helical, center-fed slot, $\lambda$ long and $<< \lambda$ wide at 1680 mc, was cut in a cylinder .222 $\lambda$ long and .16 $\lambda$ in diameter. A second requirement, arising from the need to use the entire upper portion of the nose cone for sensory equipment, was satisfied by the development of a circumferentially slotted cylinder antenna. This antenna consisted of a cylinder .2 $\lambda$ in height and .57 $\lambda$ in diameter at 1680 mc, around which four center-fed circumferential slots .6 $\lambda$ long were symmetrically placed. Both antennas proved satisfactory in engineering flight tests. They can also serve in other rocket applications where good axial coverage is desired.

The most significant result of this development is the establishment of the capability of obtaining a linearly polarized field along the axis of cylindrical antennas of small length and diameter.

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# SLOTTED CYLINDER ANTENNAS FOR RADIOSONDE SET AN/DMQ-6

## INTRODUCTION

Atmospheric soundings such as wind speed, wind direction, pressure, temperature, and humidity are obtained by means of a rawinsonde system, which consists of a radiosonde transmitter, a radio direction finder, and a meteorological recorder. With the development of the missile and rocket program, a rocket-borne radiosonde was needed to gather the high-altitude wind and temperature data required for missile design and evaluation. Radiosonde Set AN/DMQ-6, an adaptation of a balloon-borne radiosonde, was designed to fulfill this purpose.[1]

The rocket-borne radiosonde requires a compact, omnidirectional antenna with good axial coverage. Improved antenna coverage is essential, since the tracking angles are generally much higher in the rocket than in the balloon application. The first radiosonde rockets employed a Signal Corps antenna developed earlier for use in the balloon-borne radiosonde. This antenna, a stub type with a conically-shaped ground plane, is shown in Figure 1. Designed to operate in the frequency range of 1660 mc to 1700 mc and compact enough to fit into the tip of the small rocket nose cone, the stub antenna produces good radiation field coverage on ascent. There is also, however, a requirement to track the descent of the rocket nose cone, which separates from the rocket body and descends by parachute. The stub antenna provides extremely poor axial coverage for this portion of the flight.

Accordingly, a program was initiated to provide a compact new antenna of simple and rugged construction, vertically polarized and with good omnidirectional coverage, which would also permit good axial coverage in rocket applications where there was interest in the downward flight of the rocket. A helically-slotted cylinder antenna was developed to fulfill these requirements. A second requirement for the rocket-borne radiosonde antenna arose from the need to free the entire upper portion of the rocket nose cone for installation of sensory equipment. This requirement was satisfied by the development of a circumferentially-slotted cylinder antenna.

Both antennas were developed for use in the ARCAS rocket.

## HELICALLY-SLOTTED CYLINDER ANTENNA

### Design Considerations

The space in the rocket nose cone allotted to the antenna was in the form of the interior of a truncated cone with bases of diameter 1.6 inches and 0.7 inch. Given the physical limitations of the nose cone, preliminary investigations of various compact antennas indicated that some form of helical slot (slot width $\ll \lambda$) would provide the desired pattern characteristics. Since it was not practicable to determine the optimum cylinder dimensions and helix parameters theoretically, these dimensions and parameters were obtained experimentally. The dimensions of the cylinder were specifically chosen as the largest possible for the space available in order to allow the maximum degree of freedom in choosing pitch angle and slot length, and also to achieve simplicity in construction. Cylinders of smaller diameter with helical slots of varying lengths were examined. However, they were found to be less suited to this application than the larger cylinder.

## Antenna Parameters

The optimum dimensions determined for the helically-slotted cylinder, at the design frequency of 1680 mc, are given below. The subscript $\lambda$ signifies that the dimension is measured in free-space wavelengths.

| | | | |
|---|---|---|---|
| $D_\lambda$ | = diameter of helix (outer cylinder diameter) | | = 0.16 |
| $C_\lambda$ | = circumference of helix | | $\approx$ 0.5 |
| $S_\lambda$ | = spacing between turns (center to center) | | = 0.089 |
| $\alpha$ | = pitch angle | $\alpha = \tan^{-1} S/\Pi D$ | = 10° |
| $L_\lambda$ | = length of one turn | | $\approx$ 0.5 |
| $A_\lambda$ | = axial length | $A = n\ S$ | = 0.178 |
| $h_\lambda$ | = total length of cylinder | | = 0.222 |
| $w_\lambda$ | = slot width | | = 0.0088 |
| $2^L/_W$ | = ratio, slot length to slot width | | = 114 |
| n | = number of turns | | = 2 |
| $2L_\lambda$ | = slot length | | $\approx$ 1 |

In preliminary tests, the helically-slotted cylinder was center fed by a 50-ohm coaxial transmission line. In order to help meet the impedance requirements of the transmitter tube, it was necessary to reduce the VSWR of the antenna to a level of better than 2 to 1 over the frequency band. This was accomplished by lengthening the cylinder. Space restrictions limited the amount that could be added to the length of the cylinder and dictated a conical shape for the extension. The terminal impedance of the helical slot was found to be 25 ohms resistive at 1680 mc.

The transmitter of Radiosonde Set AN/DMQ-6 uses a JRC 5794 tube to which the antenna is directly connected. This tube was designed to operate into a 50-ohm resistive load. Since it was necessary to match the slot antenna to a 50-ohm output, a quarter-wave transformer was constructed from 35-ohm coaxial cable for use as the feed line. While it was not possible to measure directly the impedance of this arrangement, the power output proved to be at least as good as that of the dipole antenna used previously. Power output will be affected and superregeneration may be caused by conditions of mismatch of oscillator internal impedance and load impedance.

The basic slot antenna with its conical extension is shown in Figure 2. Diagrams presented in Appendix I give exact dimensions and details of construction, as well as the method used to mount the antenna on the JRC 5794 transmitter tube.

## Radiation Pattern Characteristics

The customary dimensional criteria used to determine the axial mode of radiation for a wire-wound helix cannot be used for the helical slot, since the wire-wound helix is a traveling-wave device while the helical slot is a standing-wave antenna. In the case of the wire-wound helix, which is circularly polarized, the criterion for $C_\lambda$ in the axial mode[2] is $3/4 < C_\lambda < 4/3$. The helical slot antenna, on the other hand, radiates in an axial mode with $C_\lambda = .5$, and is linearly polarized.

The coordinate system used in taking pattern measurements of the helical slot antenna and the field components are shown in Figure 3. The dot-dash line through the center feed point lies in the XZ plane. The direction of polarization of this antenna is parallel to the diameter of the cylinder that passes through the feed point. Figures 4 and 5 show the measured $E_\theta$ ($\theta$, $\phi = 0$) and $E_\phi$ ($\theta$, $\phi = 90$) voltage patterns. The $E_\theta$ ($\theta = 90$, $\phi$) pattern is shown in Figure 6. Since the nose cone spins throughout its entire flight, omnidirectional coverage is obtained from this pattern.

Patterns to determine polarization were taken by rotating the slotted cylinder about its own axis, the z axis, with the receiving antenna located on the z axis. Figure 7 is such a pattern, taken with the receiving antenna horizontally polarized. In Figure 8, the receiving antenna is vertically polarized. These patterns clearly illustrate that the dominant radiation is linearly polarized.

The patterns of the helically-slotted antenna which are reproduced in this report, Figures 4 through 8, were taken with the antenna mounted on the Radiosonde Set AN/DMQ-6 and with a conical sleeve used as a ground plane, as shown in Figure 9. Satisfactory results have been achieved from rocket flights in which the radiosonde set lacked the conical sleeve ground plane; it is needed, however, to obtain the best results. Since no electrical connection is necessary between the ground plane and the nose cone, a satisfactory ground plane could be obtained by metallizing the interior portion of the plastic nose cone cover below the section covering the antenna.

Figure 10 is the pattern of the $E_\theta$ component as a function of $\theta$ in the XZ plane (see Figure 4) but with the nose cone mounted on the entire rocket body. Figure 11, in turn, shows the pattern change in the case of the $E_\phi$ component as a function of $\theta$ in the YZ plane when the nose cone is mounted on the rocket body. (Compare with Figure 5.)

The measurement setup used to take the principal plane patterns of the nose cone is shown in the diagram of Figure 12. Polarization patterns of the nose cone were made with the measurement setup presented in Figure 13. Figure 14 is a photograph of the measurement setup used to take the $E_\theta$ and $E_\phi$ patterns of the complete rocket assembly.

While the $E_\phi$ ($\theta$, $\phi = 90$) patterns appear to be similar to axial-mode patterns, the $E_\theta$ ($\theta$, $\phi = 0$) patterns do not. The explanation for the asymmetry of the $E_\theta$ pattern probably lies in the fact that linear currents are set up on the cylinder, parallel to its axis, giving rise to an anti-symmetric pattern for $E_\theta$ polarization. This pattern interferes with the $E_\theta$ pattern from the helix, causing asymmetry.

Figure 15 presents the complete system layout and indicates the type of pattern coverage required. Since the nose cone spins on both ascent and descent, a vertically polarized component is seen by the receiver from all possible flight positions, including the one in which the nose cone is directly over the receiver.

## CIRCUMFERENTIALLY-SLOTTED CYLINDER ANTENNA

### Description

This antenna was designed to fit into the lower portion of the rocketsonde nose cone, in order to leave the upper portion free for installation of sensory equipment. The antenna size was limited by the inside diameter of the lower part of the nose cone, which averaged 4.2 inches. The design was centered around a cylinder 1.5 inches ($\sim .2\lambda$) in height with an outer diameter of 4 inches ($\sim .57\lambda$). Lambda ($\lambda$) is measured at 1680 mc.

Four circumferential slots $.6\lambda$ long were placed symmetrically around the cylinder. Since the length of each slot was greater than a quadrant, two slots, 180 degrees apart, were placed 0.25 inch above the center circumferential reference line. The remaining two slots, rotated 90 degrees away from the first pair, were placed 0.25 inch below the center reference line. The positioning of the slots may be seen in Figure 16, which shows the assembled antenna. The slot length of $.6\lambda$ was experimentally determined to achieve resonance for this configuration. The single slot impedance, at resonance, agreed fairly well with theoretical considerations. The resonant slot length increased, however, when the number of slots was increased to four.

A cylinder 2 inches in diameter, placed within and concentric to the larger cylinder, was held in position by top and bottom plates, forming a cavity approximately $.25\lambda$ in depth. The component parts of the circumferentially-slotted cylinder antenna are shown in Figure 17. Figure 18 presents the top view with the plate removed, showing the slot feed arrangement. In Figure 19 the top view is seen with the plate in place.

In order to obtain endfire radiation from the slotted cylinder, one pair of adjacent slots had to be fed in antiphase to the other pair of slots. This was done by making the feed lines to one pair of slots $\lambda/2$ longer than the feed lines to the other two slots. Each slot was center fed by a separate cable, with the four cables terminating in a common connection to the transmitter tube. Other feeding arrangements were tried, but this one proved to be the best electrically and also the simplest to reproduce. The feed system is still under study for use in other applications.

### Radiation Pattern Characteristics

The end-fire radiation characteristics of the four-slot circumferential antiphase antenna are quite similar to those of the helically-slotted antenna. The pattern of this antenna is linearly polarized in a direction parallel to a diameter line through the center of the overlap of inphase slots. The pattern coordinate system and field components are shown in Figure 20. The dot-dash line through the center of slot overlap lies in the XZ plane. Figures 21 and 22 show the measured $E_\theta$ ($\theta$, $\phi = 0$) and $E_\phi$ ($\theta$, $\phi = 90$) voltage patterns. The $E_\theta$ ($\theta = 90$, $\phi$) pattern is shown in

Figure 23. This pattern provides omnidirectional coverage by virtue of the spinning of the nose cone throughout its entire flight.

Polarization patterns for the circumferentially-slotted cylinder antenna, as for the helically-slotted cylinder antenna, were taken by rotating the cylinder about its own axis, with the receiving antenna located on the axis. The polarization pattern shown in Figure 24 was taken with the receiver horizontally polarized. Figure 25 shows a polarization pattern taken with the receiver vertically polarized. Again we see that the dominant radiation is linearly polarized. However, for small variations from an exact 180° phase difference between the slot pairs, the radiated wave deviates somewhat from the linearly polarized condition. Although this circumstance is not undesirable for the present application, little effort was expended toward its constructive utilization.

The patterns in Figures 21-25 were taken with the circumferentially-slotted cylinder antenna mounted on a mock-up of Radiosonde Set AN/DMQ-6 (Figure 26.) $E_\theta$ and $E_\phi$ patterns were taken with antenna and nose cone mounted on the Arcas rocket body (Figures 27 and 28).

The same argument offered as an explanation of the asymmetry of the $E_\theta$ patterns as opposed to the comparative symmetry of the $E_\phi$ patterns of the helically-slotted antenna, applies to the circumferentially-slotted antenna. However, the $E_\theta$ pattern of the circumferentially-slotted antenna is more symmetrical than that of the helically-slotted antenna. This is possibly due to the symmetrical distribution of the slots about the cylinder and the feeding arrangement.

The exact dimensions and details of construction of the circumferentially-slotted antenna and the method of connecting it to the JRC 5794 tube are given in Appendix II.

## CONCLUSIONS

The helically-slotted and circumferentially-slotted antennas described in this report were designed specifically for use with a Radiosonde Set AN/DMQ-6, mounted in an Arcas rocket nose cone. Both antennas proved satisfactory in engineering flight tests.

These slotted cylinder antennas can also serve in other rocket applications where good axial coverage is desired. The most significant result of this development is the establishment of the capability of obtaining a linearly polarized radiation field along the axis from slotted antennas less than $\lambda/4$ in length and of small diameter.

## RECOMMENDATIONS

While the predominant axial radiation field of the slotted cylinders investigated is linearly polarized, evidence from some of the pattern measurements suggests the possibility of obtaining a circularly polarized axial field from the antennas. Further investigation in this connection is recommended.

Another area of investigation which may prove profitable is the possibility of using these antennas as primary elements in larger antenna systems.

## ACKNOWLEDGMENTS

The authors wish to express appreciation to Mr. Boaz Gelernter of Advanced Development Branch, Radar Division, for his advice and assistance in this development.

Thanks are extended to Mr. Arthur A. Coppola for permission to reprint his diagram of the complete system layout (Fig. 15) from USAELRDL Technical Report 2171. (See Reference 1.)

## REFERENCES

1. Coppola, Arthur A., "Use of Rawin Set AN/GMD-2 with Radiosonde Set AN/DMQ-6," USASRDL Technical Report 2171, January 1961.

2. Kraus, J. D., Antennas, p.185, McGraw-Hill Book Company, Inc., New York (1950).

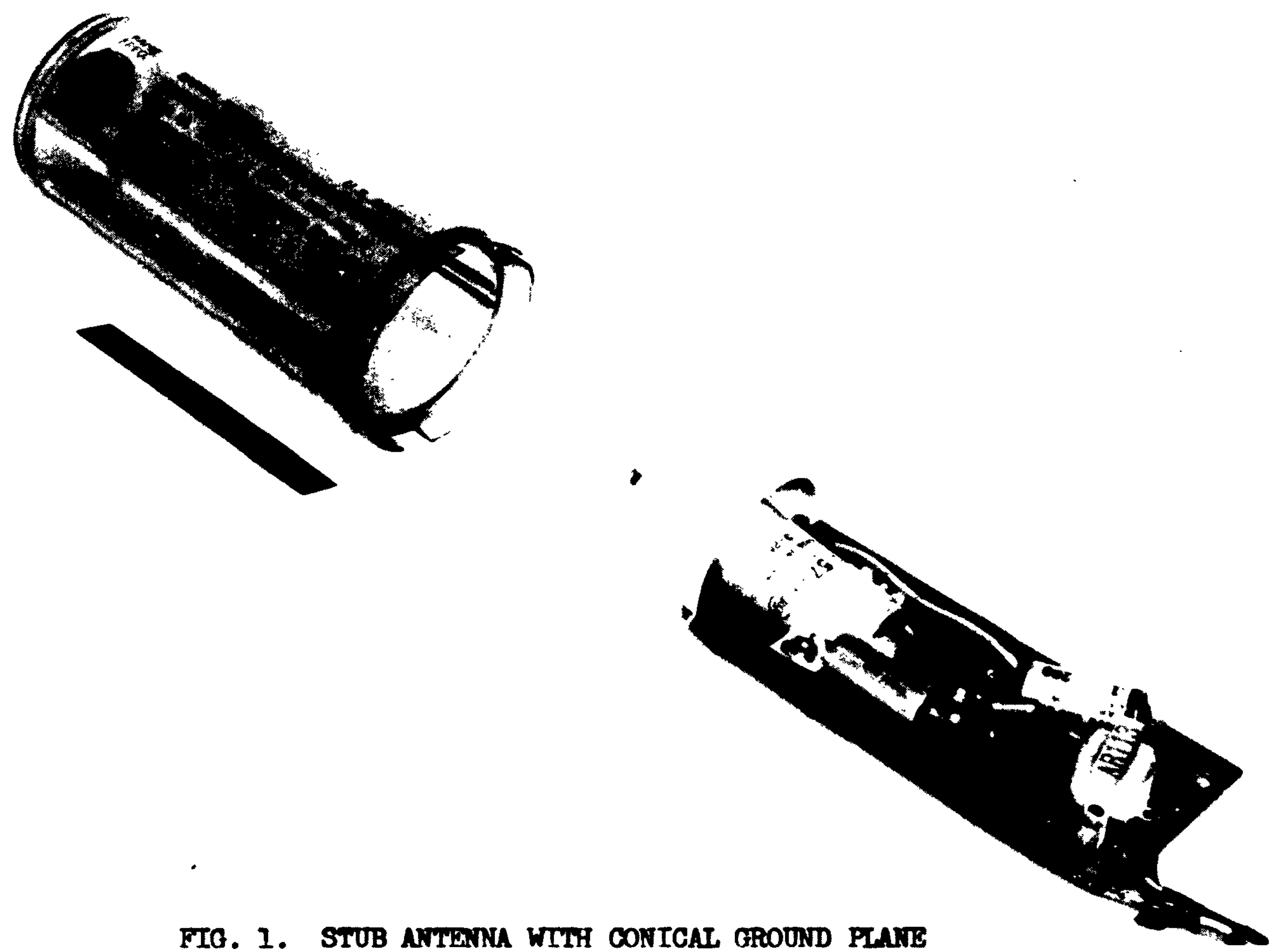


FIG. 1. STUB ANTENNA WITH CONICAL GROUND PLANE

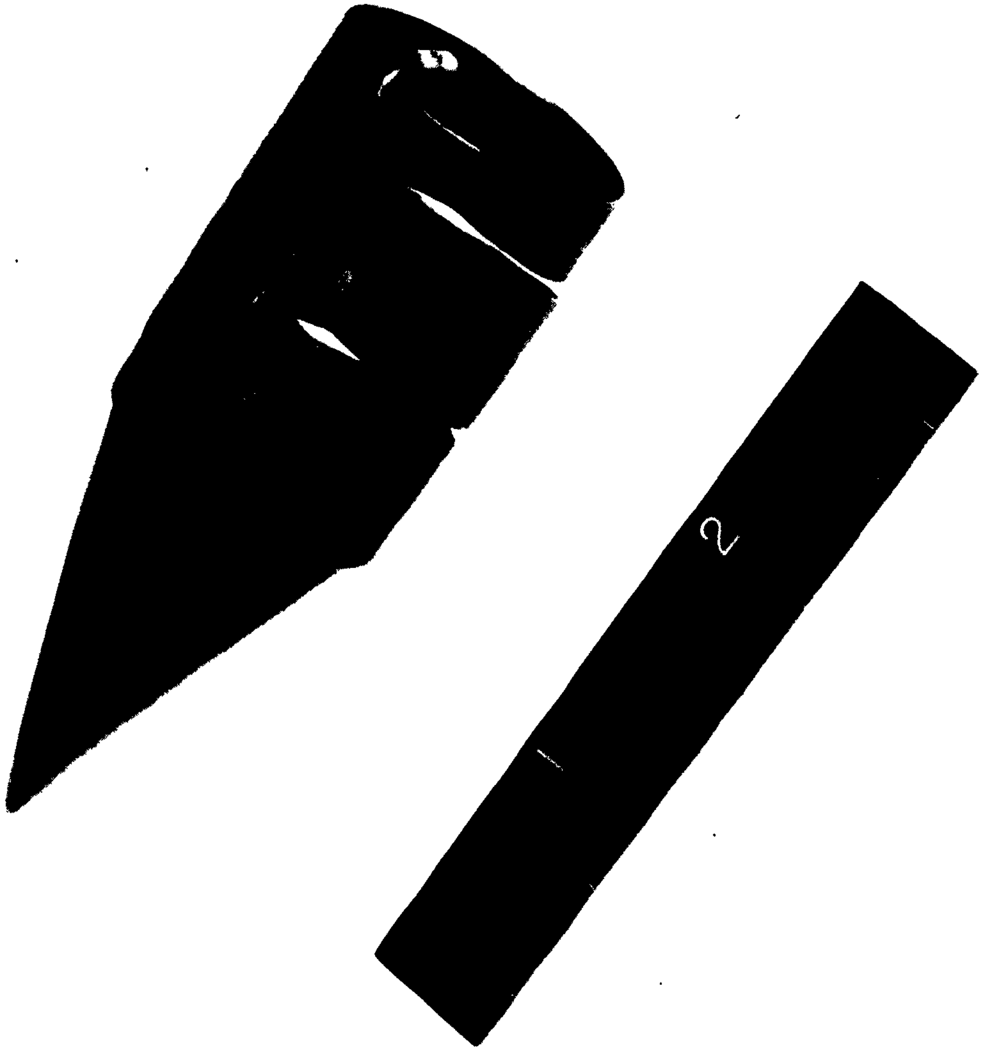


FIG. 2. HELICALLY-SLOTTED CYLINDER ANTENNA

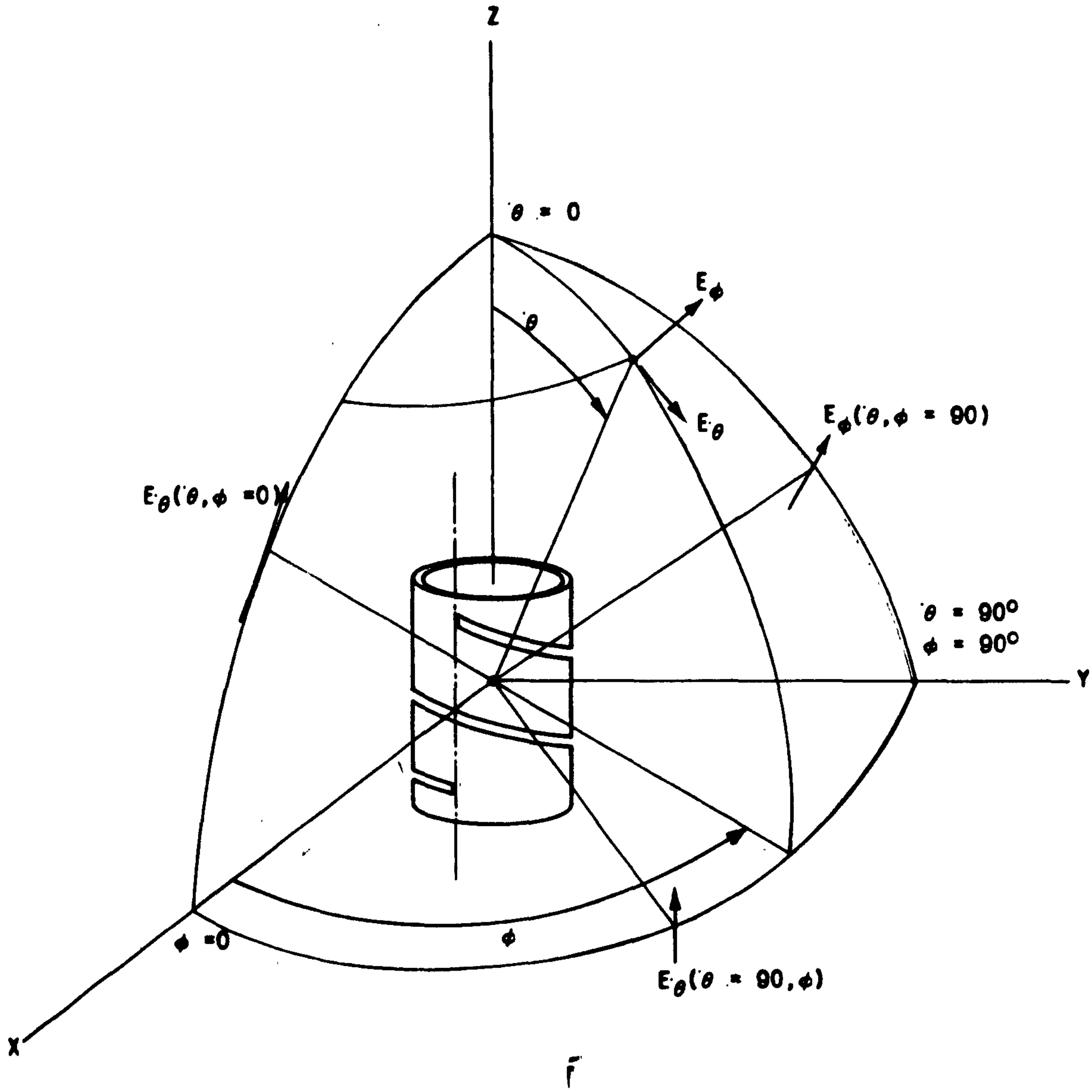



FIG. 3. COORDINATE SYSTEM FOR HELICALLY-SLOTTED CYLINDER ANTENNA

## POLAR CHART

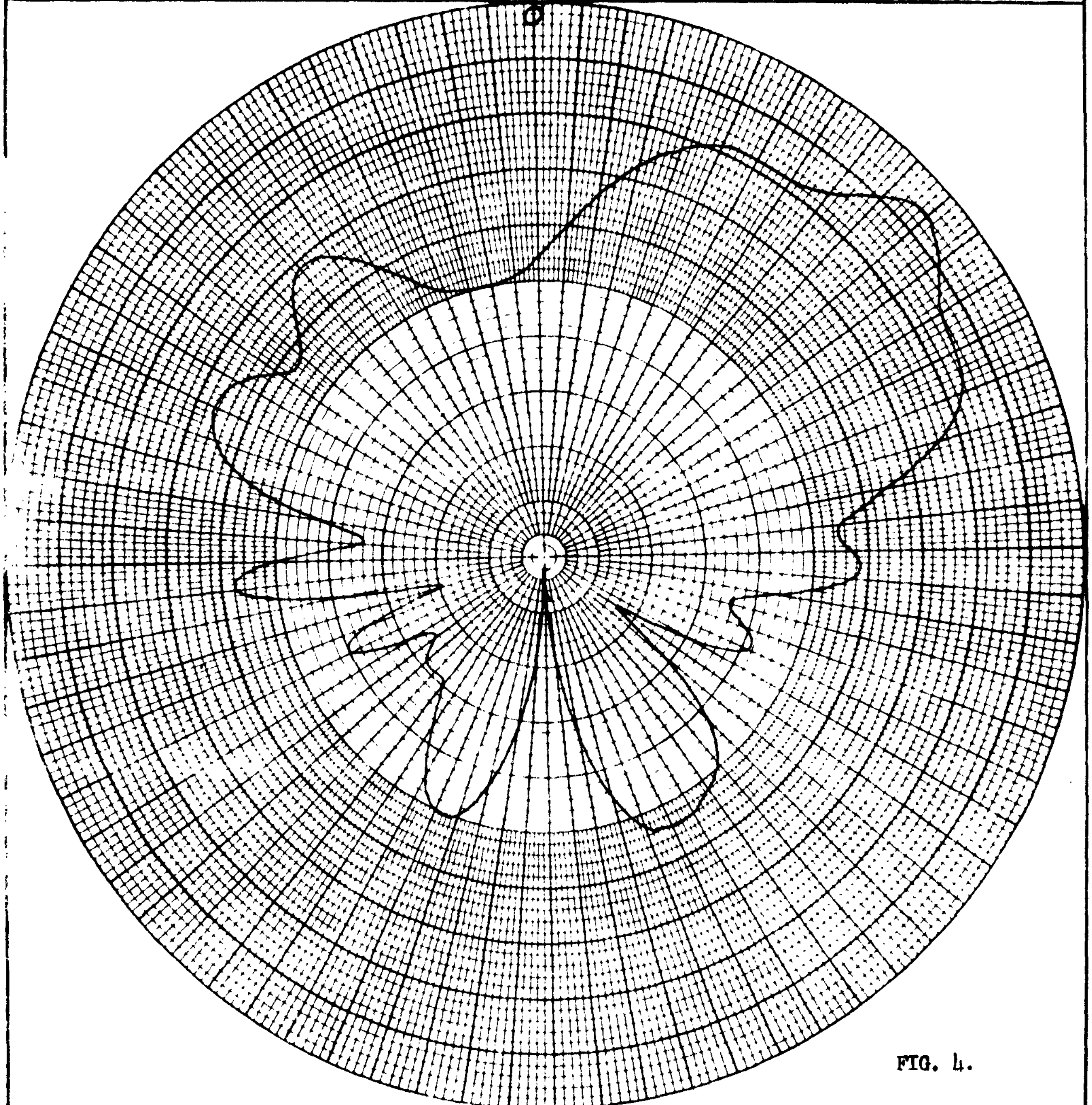
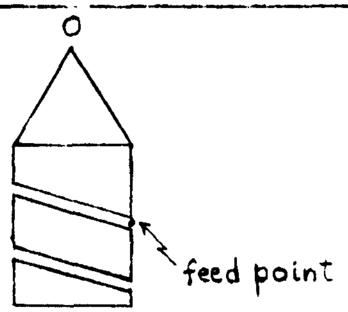



FIG. 4.

DIAGRAM




MODEL
HELICALLY-SLOTTED CYLINDER ANTENNA

| ACTUAL FREQ (MC/S) | SCALE FREQ (MC/S) | COMPONENT | |
|---|---|---|---|
| 1690 | | E | $E_\theta(\theta, \phi=0)$ |

REMARKS
Pattern of θ component of electric field as a function of θ in the x-z plane (φ=0).

| DATE | NR. | TASK NR. |
|---|---|---|
| | | |

## POLAR CHART

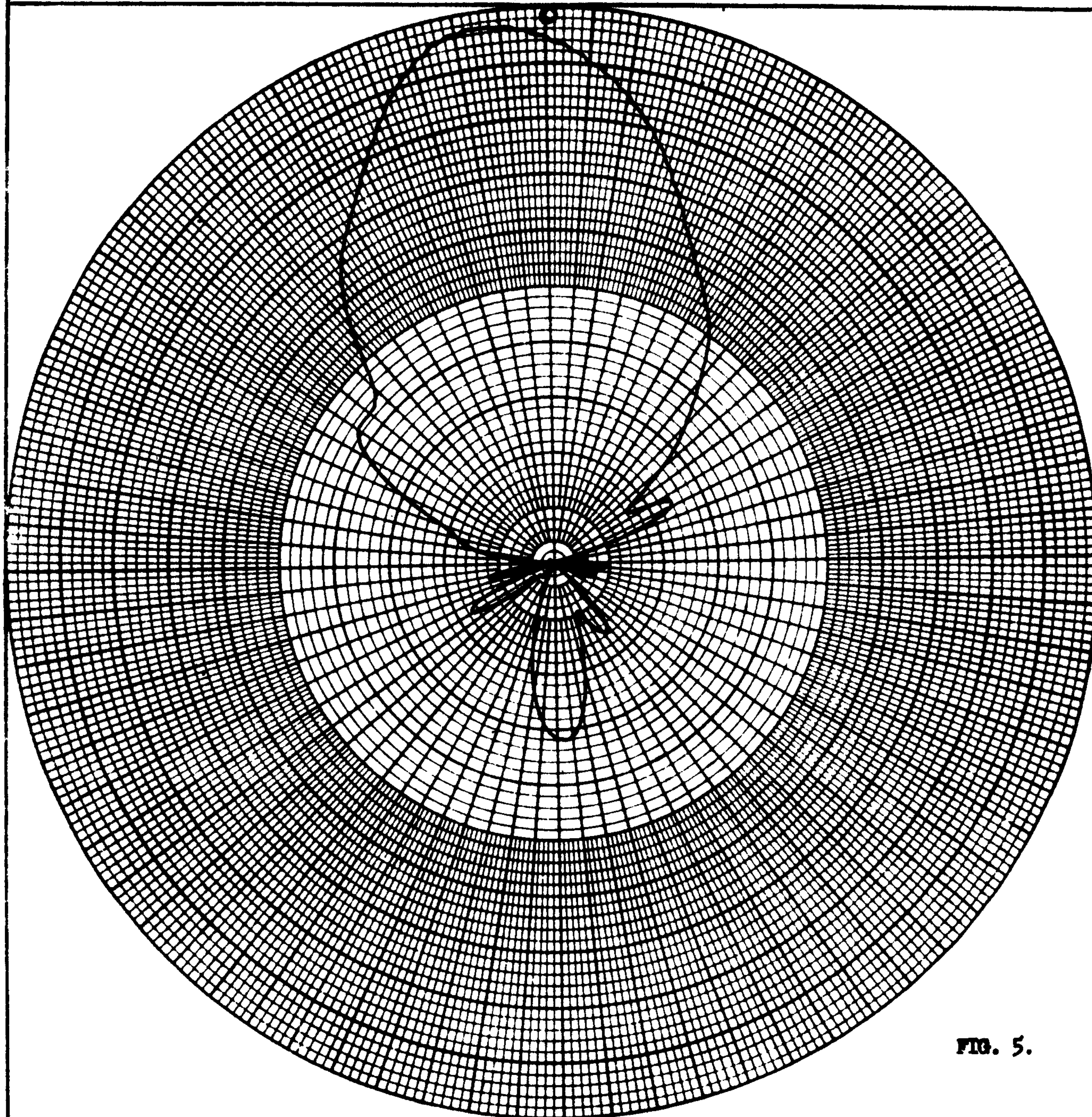
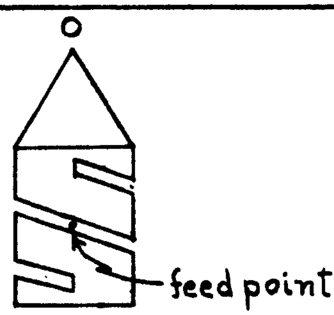


FIG. 5.

DIAGRAM




| | | | |
|---|---|---|---|
| MODEL: HELICALLY-SLOTTED CYLINDER ANTENNA | | | |
| ACTUAL FREQ (MC/S): 1690 | SCALE FREQ (MC/S): | COMPONENT: $E\phi(\theta, \phi = 90)$ | $E\theta$ |
| REMARKS: Pattern of $\phi$ component of electric field as a function of $\theta$ in the y-z plane ($\phi = 90$). | | | |
| DATE: 11 | NR. | TASK NR. | |

POLAR CHART

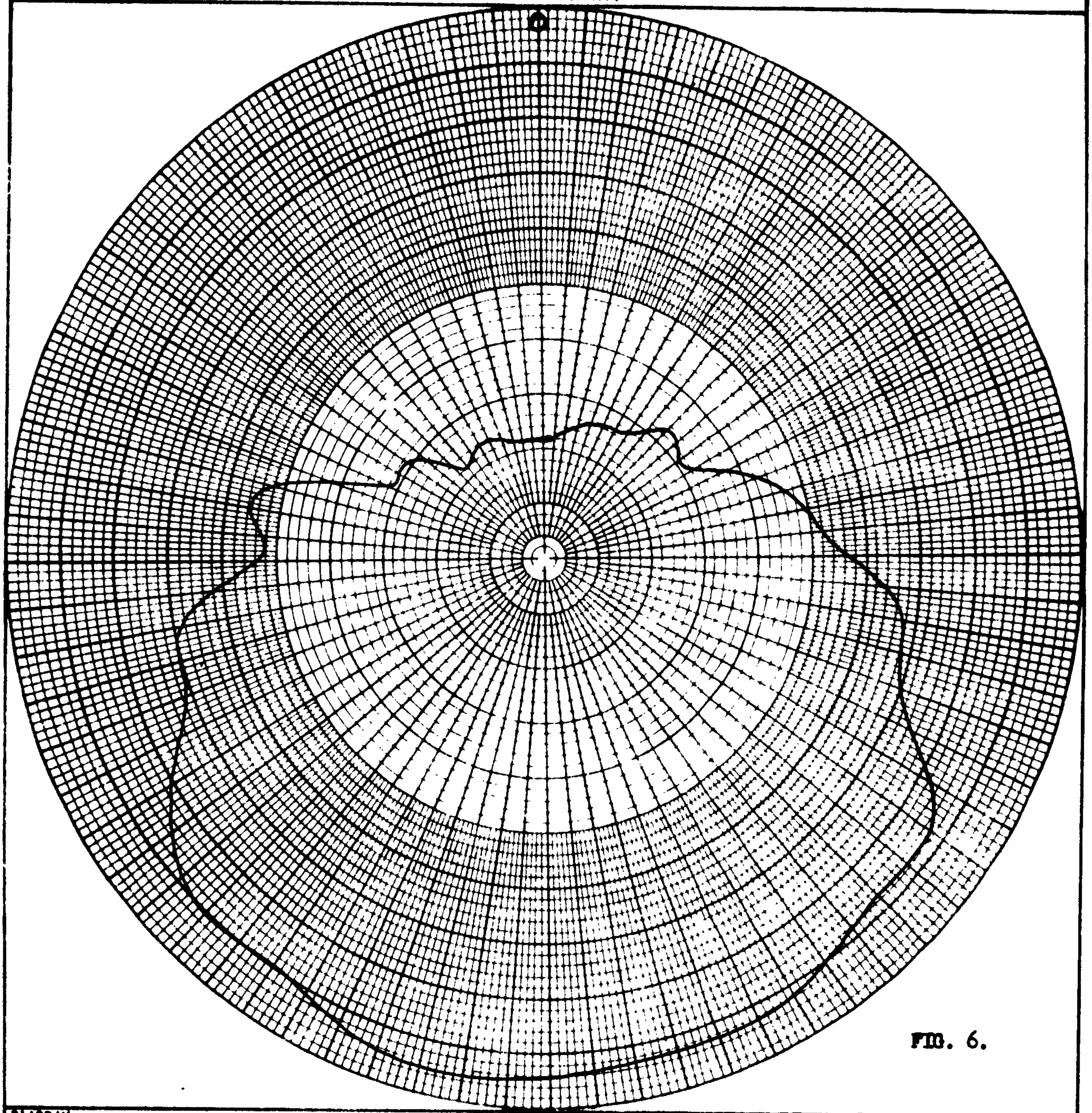
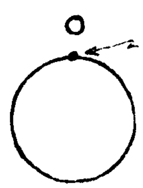



FIG. 6.

DIAGRAM




| | | |
|---|---|---|
| MODEL<br>HELICALLY-SLOTTED CYLINDER ANTENNA | | |
| ACTUAL FREQ (MC/S)<br>1690 | SCALE FREQ (MC/S) | COMPONENT<br>E J $E_{\theta}(\theta=90,\phi)$ |
| REMARKS<br>Pattern of θ component of electric field as a function of φ in the x-y plane (θ = 90) | | |
| DATE<br>12 | NR. | TASK NR. |

POLAR CHART

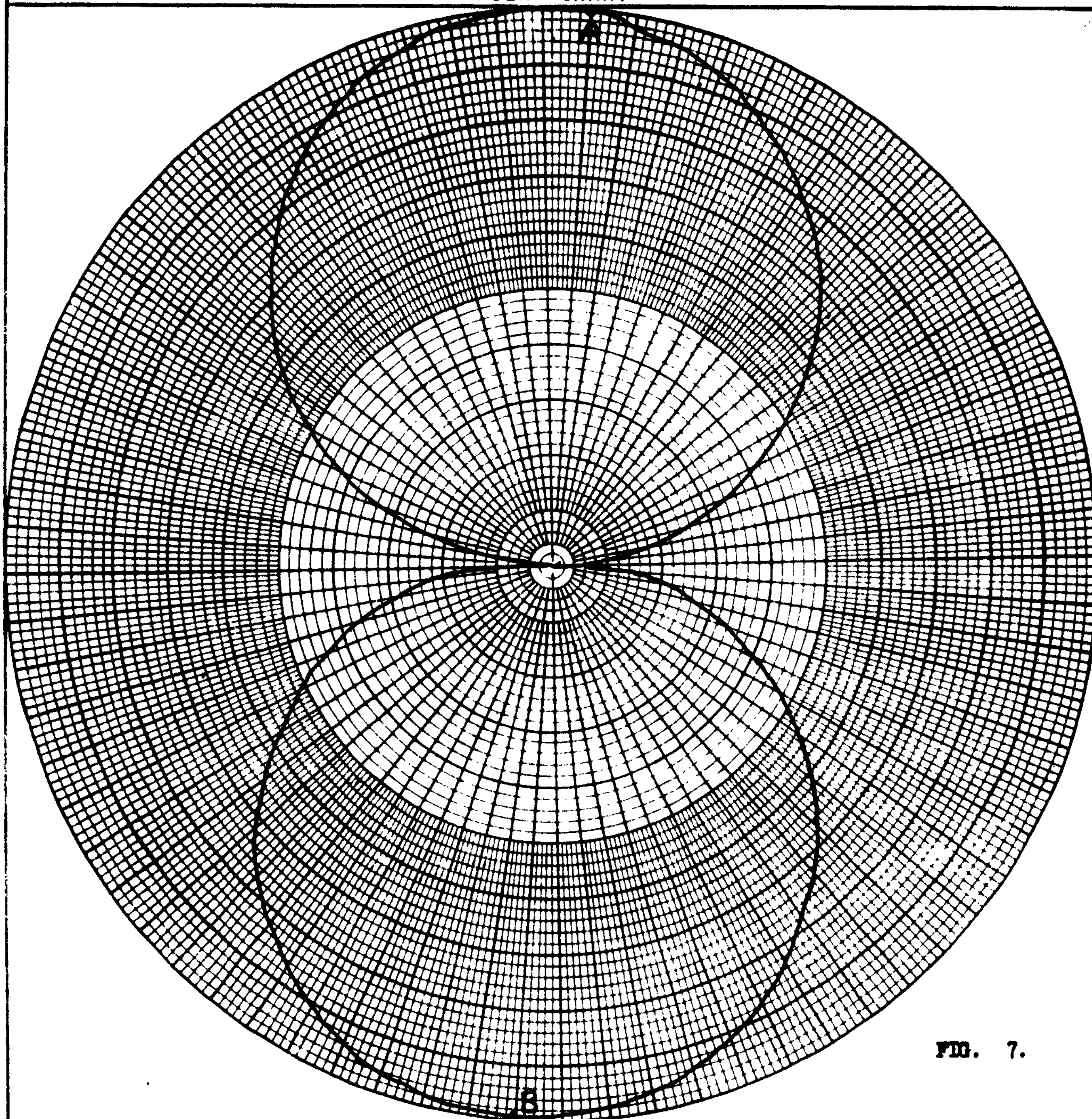
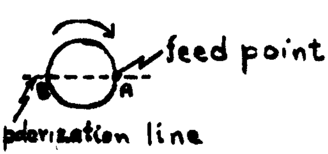



FIG. 7.

DIAGRAM




Feed point positions for maximum intensity, A and B.

MODEL
HELICALLY-SLOTTED CYLINDER ANTENNA

| ACTUAL FREQ (MC/S) | SCALE FREQ (MC/S) | COMPONENT | |
|---|---|---|---|
| 1690 | | E $\phi$ | E $\theta$ |

REMARKS Polarization Pattern
Receiver Horizontally Polarized

| DATE | NR. | TASK NR. |
|---|---|---|
| 13 | | |

## POLAR CHART

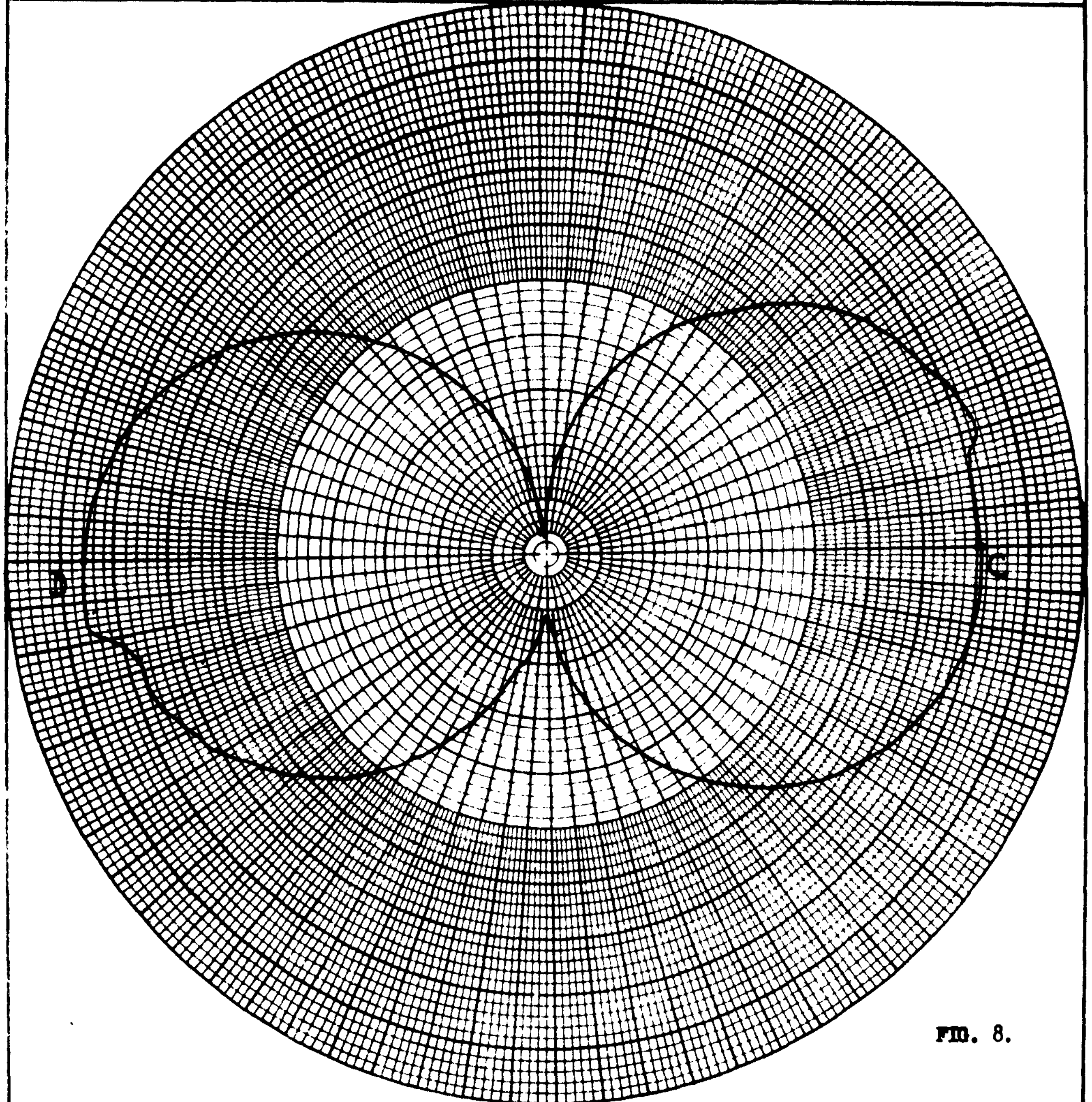
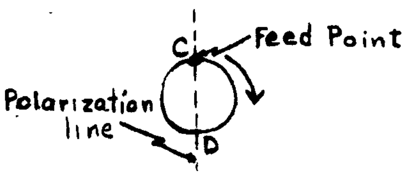



FIG. 8.

| DIAGRAM | MODEL HELICALLY-SLOTTED CYLINDER ANTENNA | | | |
|---|---|---|---|---|
| | ACTUAL FREQ (MC/S) 1690 | SCALE FREQ (MC/S) | COMPONENT $E\phi$ | $E\theta$ |
| | REMARKS Polarization Pattern Receiver Vertically Polarized | | | |
| Feed point positions for maximum intensity, A and B. | DATE 14 | NR. | TASK NR. | |



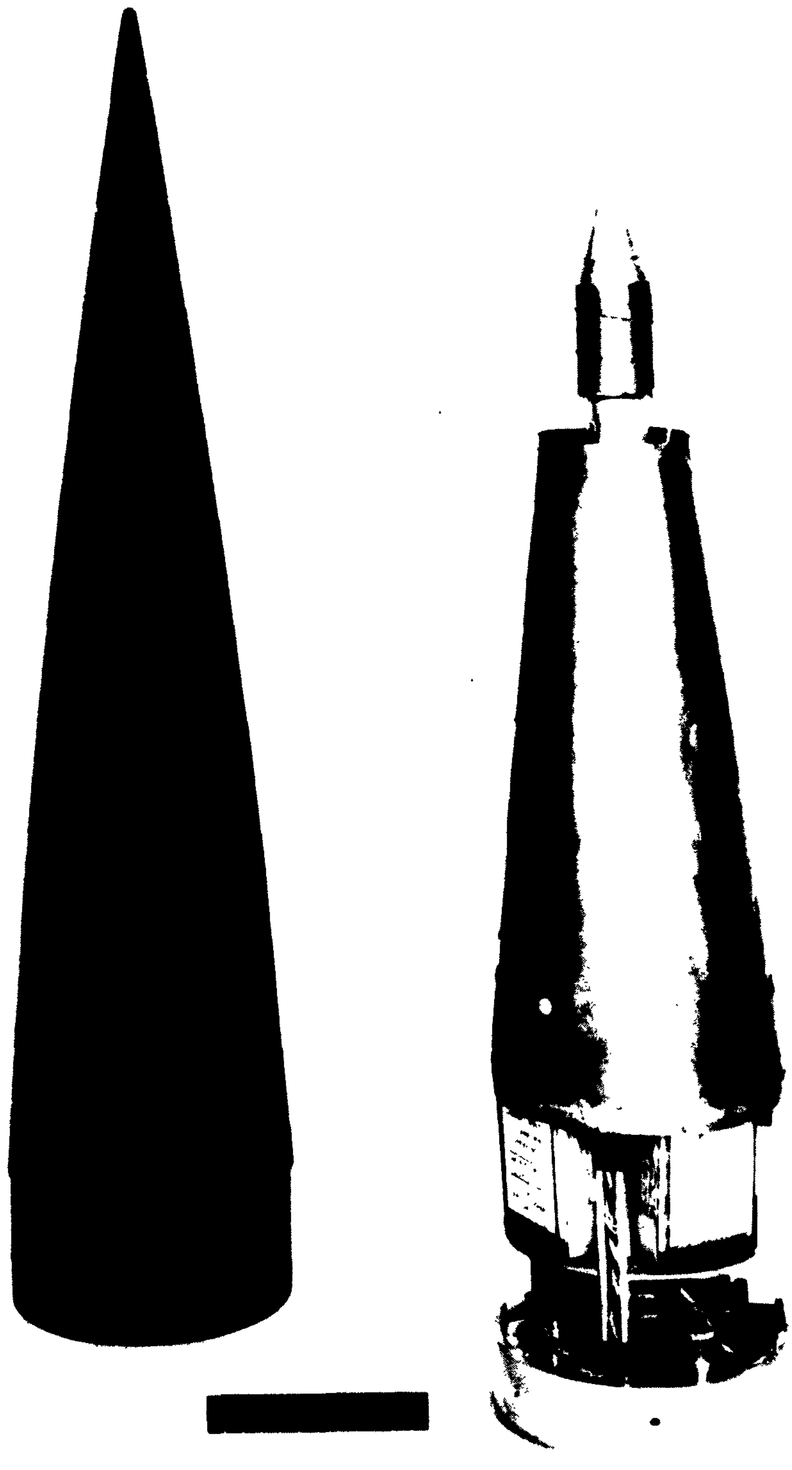


FIG. 9. HELICALLY-SLOTTED CYLINDER ANTENNA MOUNTED ON RADIOSONDE and CONICAL SLEEVE GROUND PLANE

POLAR CHART

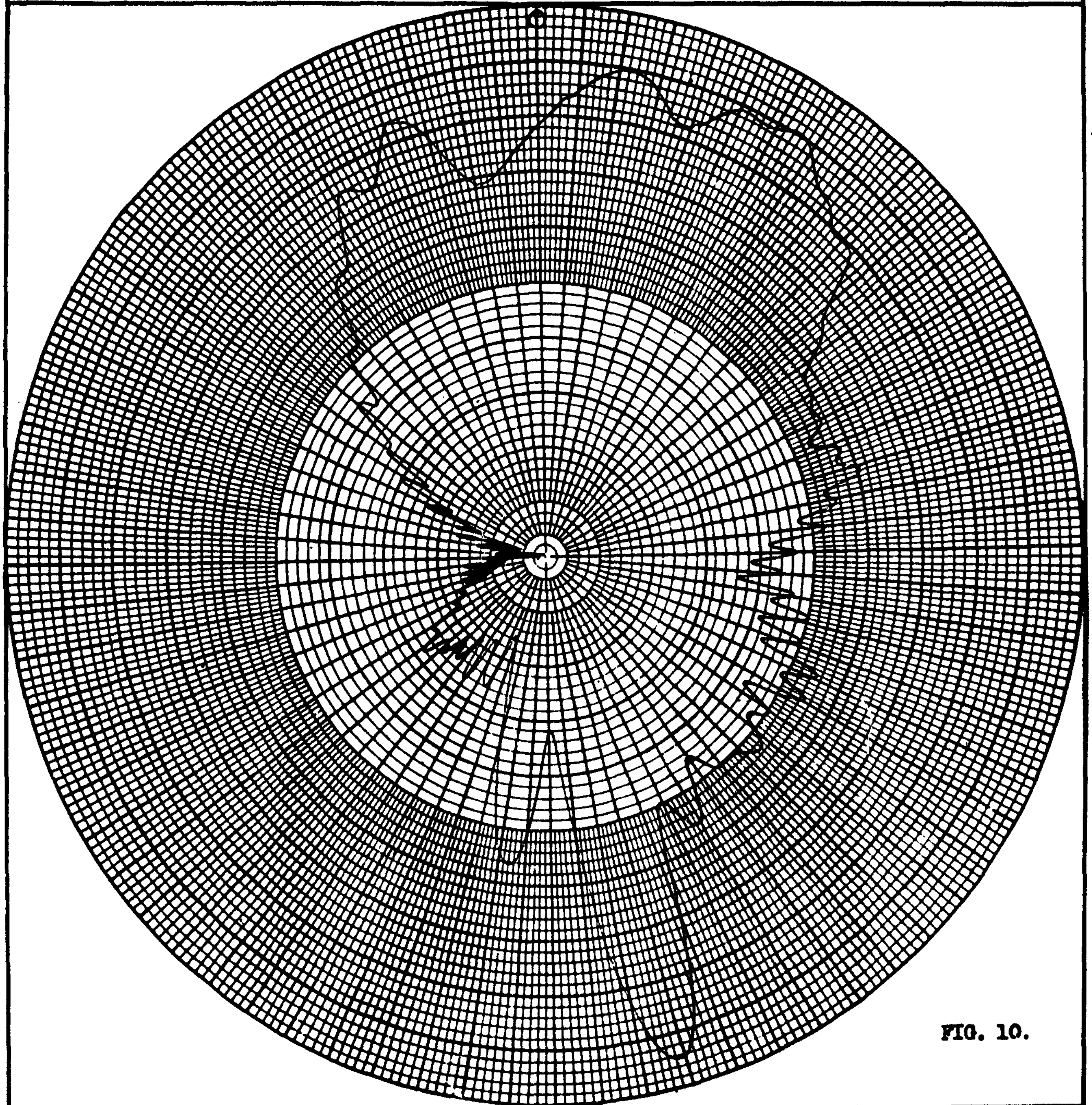


FIG. 10.

HELICALLY-SLOTTED CYLINDER ANTENNA MOUNTED ON ARCAS ROCKET

| ACTUAL FREQ (MC/S) | SCALE FREQ (MC/S) | COMPONENT | |
|---|---|---|---|
| 1690 | | E $\Phi$ | $E_\theta(\theta, \phi = 0)$ |

REMARKS

Compare with Figure 4.

| DATE | NR. | TASK NR. |
|---|---|---|
| 16 | | |

POLAR CHART

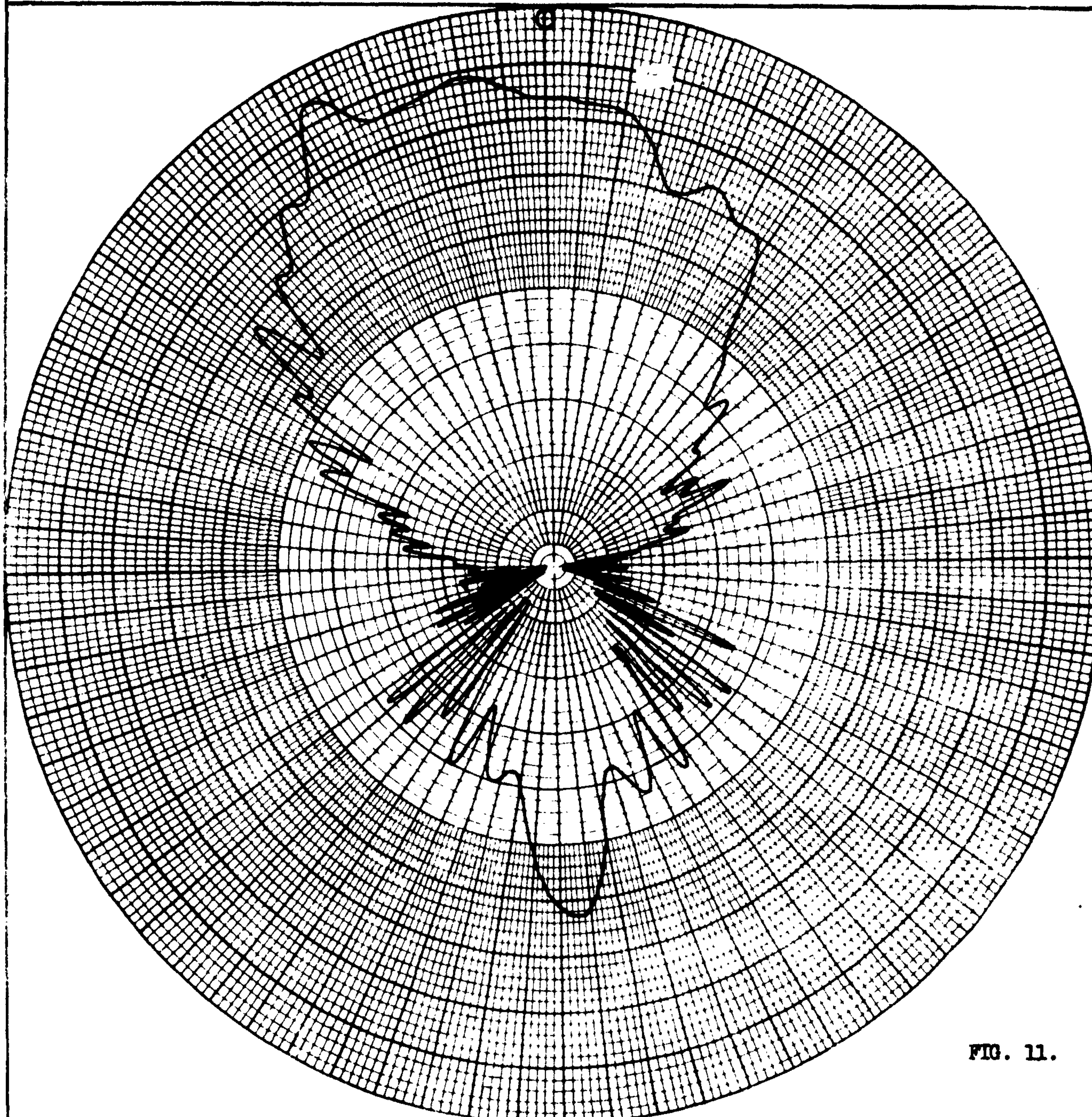


FIG. 11.

**HELICALLY-SLOTTED CYLINDER ANTENNA MOUNTED ON ARCAS ROCKET**

| ACTUAL FREQ (MC/S) | SCALE FREQ (MC/S) | COMPONENT |
|---|---|---|
| 1690 | | $E\phi(\theta, \phi = 90)$ $E\theta$ |

REMARKS

**Compare with Figure 5.**

| DATE | NR. | TASK NR. |
|---|---|---|
| 17 | | |

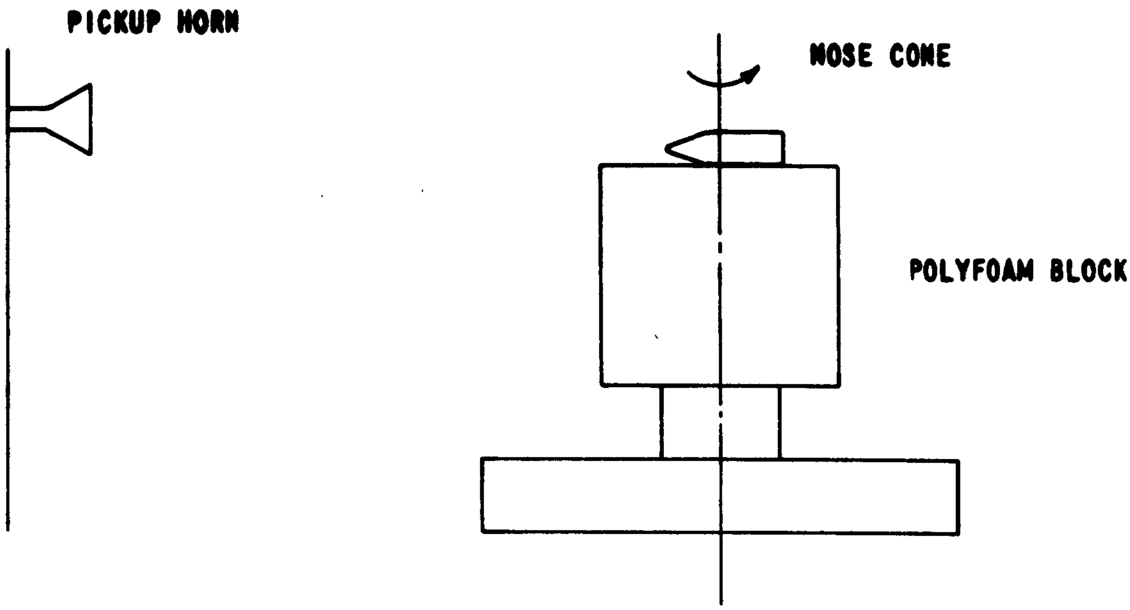



FIG. 12. MEASUREMENT SETUP FOR PRINCIPAL PLANE PATTERNS

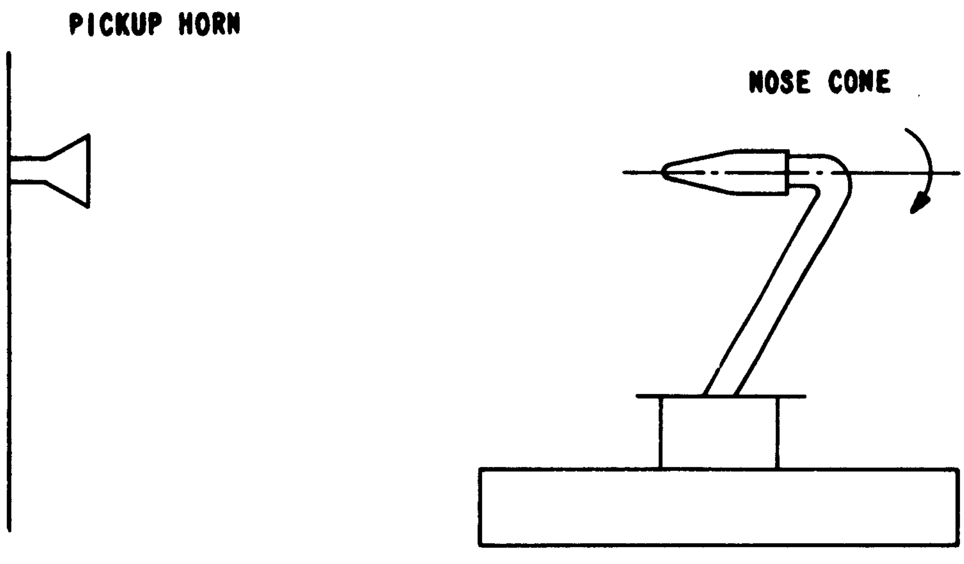



FIG. 13. MEASUREMENT SETUP FOR POLARIZATION PATTERNS

FIG. 14. MEASUREMENT SITE SHOWING ROCKETSONDE MOUNTED ON ARCAS ROCKET

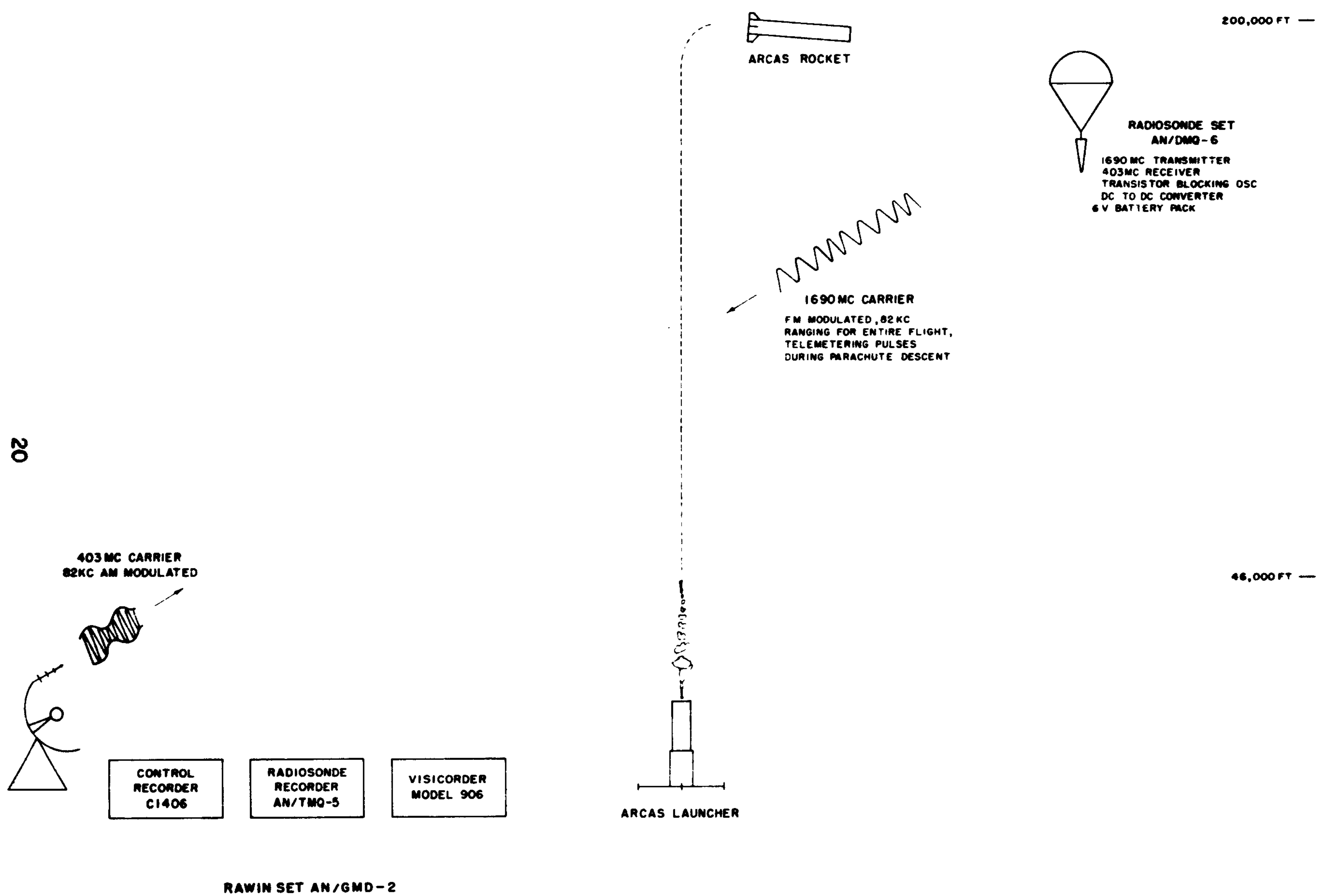



FIG. 15. COMPLETE SYSTEM LAYOUT

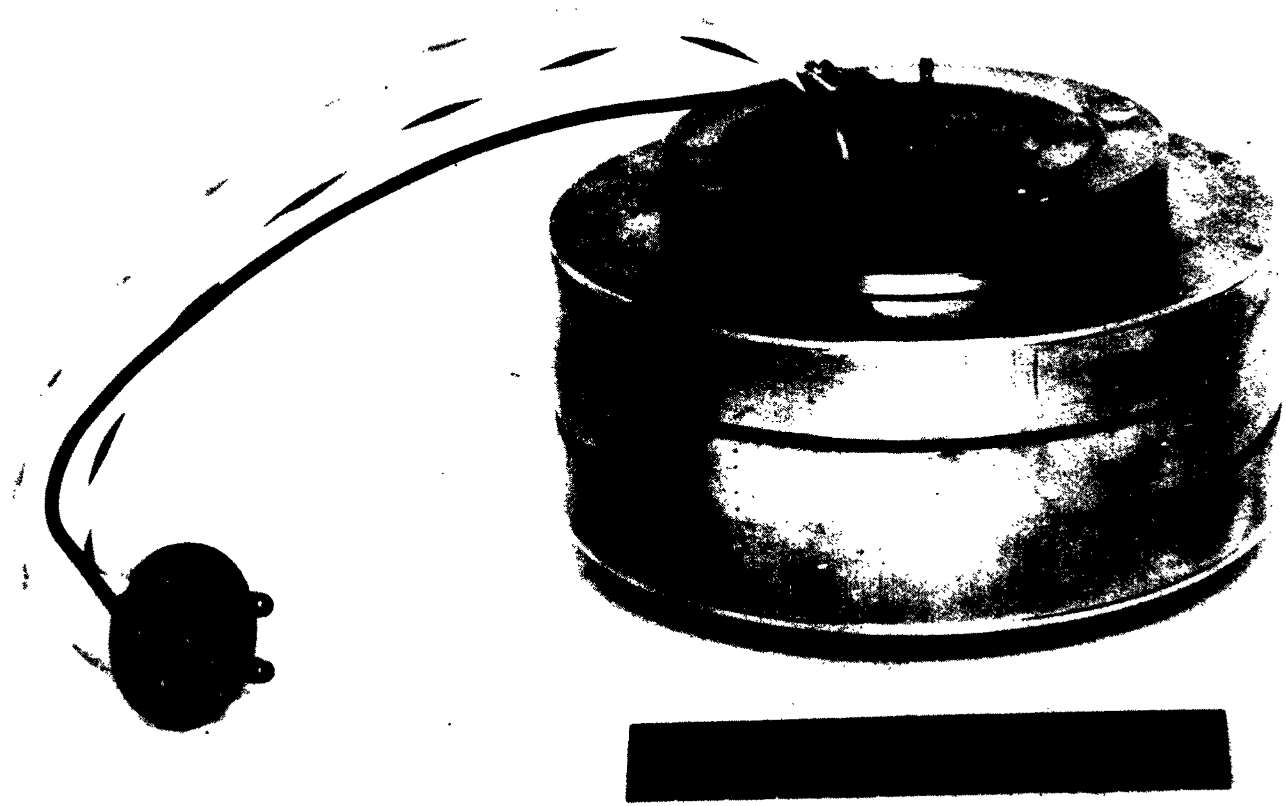


FIG. 16. CIRCUMFERENTIALLY-SLOTTED CYLINDER ANTENNA, ASSEMBLED

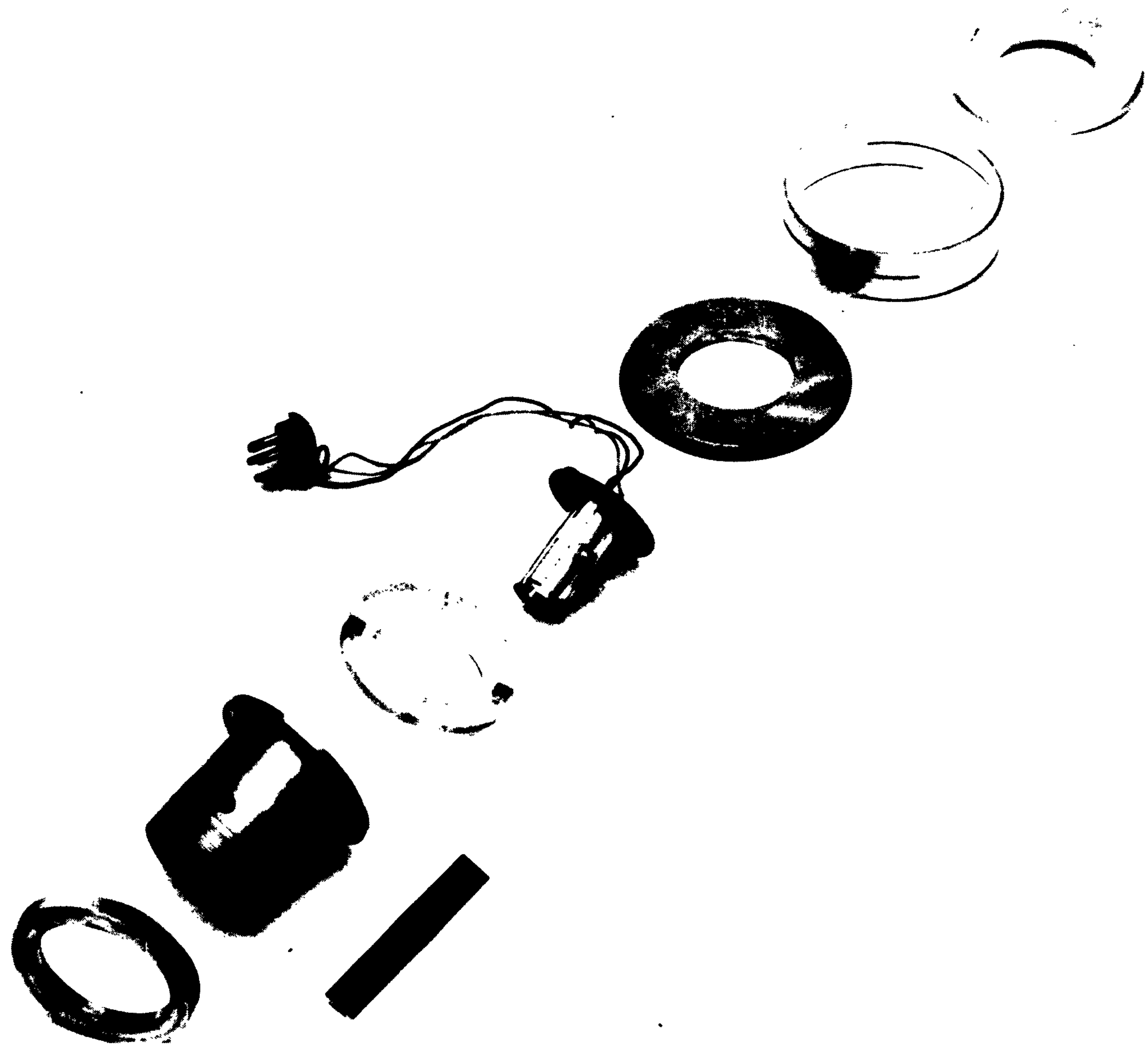


FIG. 17. CIRCUMFERENTIALLY-SLOTTED CYLINDER ANTENNA SHOWING COMPONENT PARTS

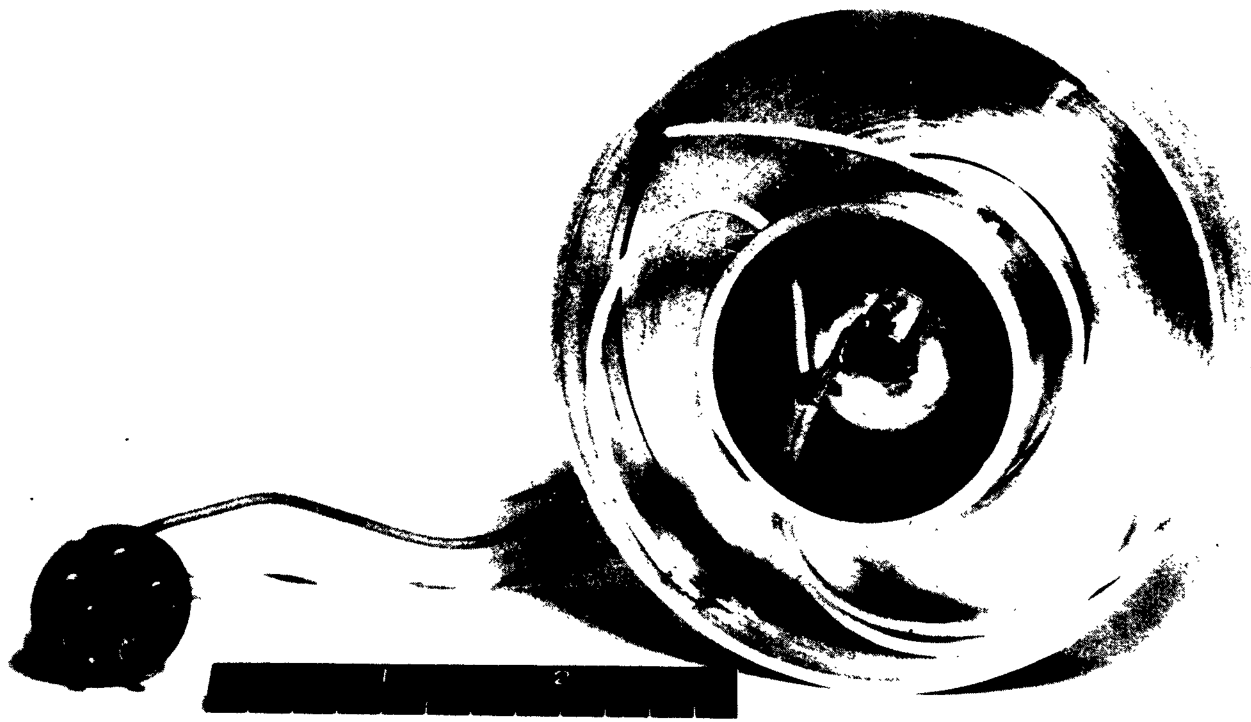


FIG. 18. CIRCUMFERENTIALLY-SLOTTED CYLINDER ANTENNA
TOP PLATE REMOVED

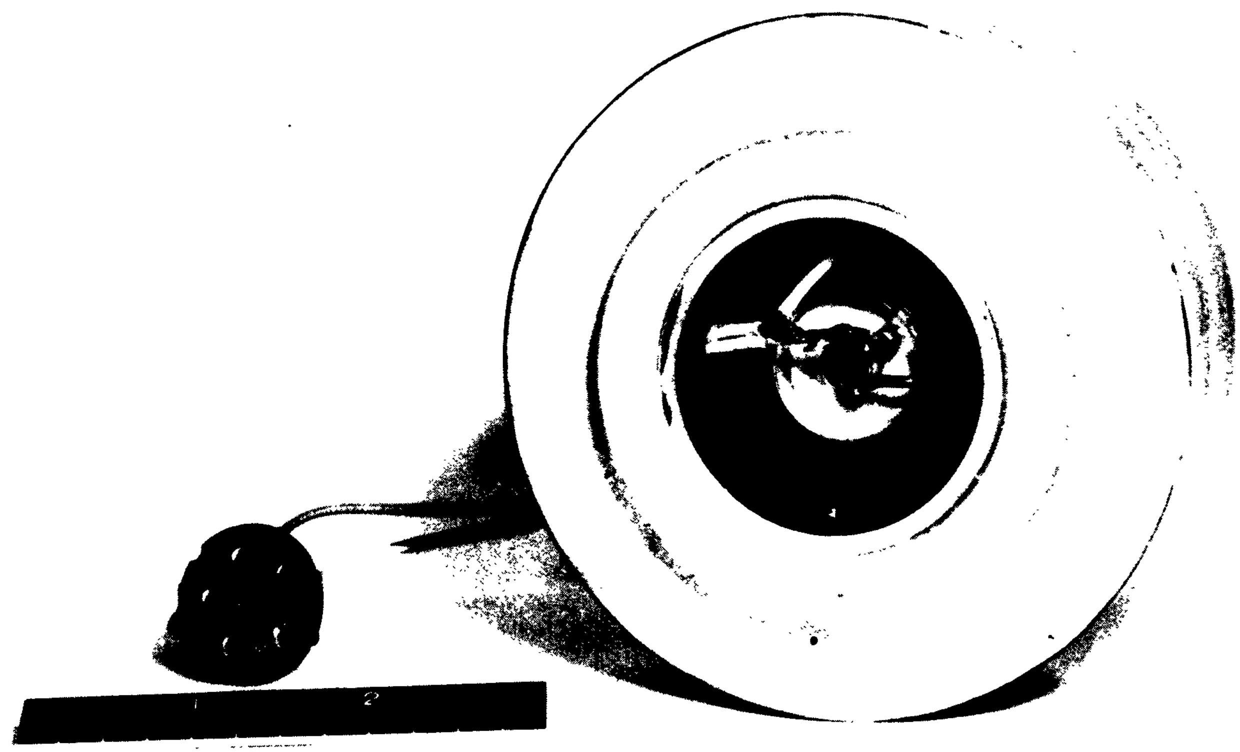



FIG. 19. CIRCUMFERENTIALLY-SLOTTED CYLINDER ANTENNA
TOP PLATE IN PLACE

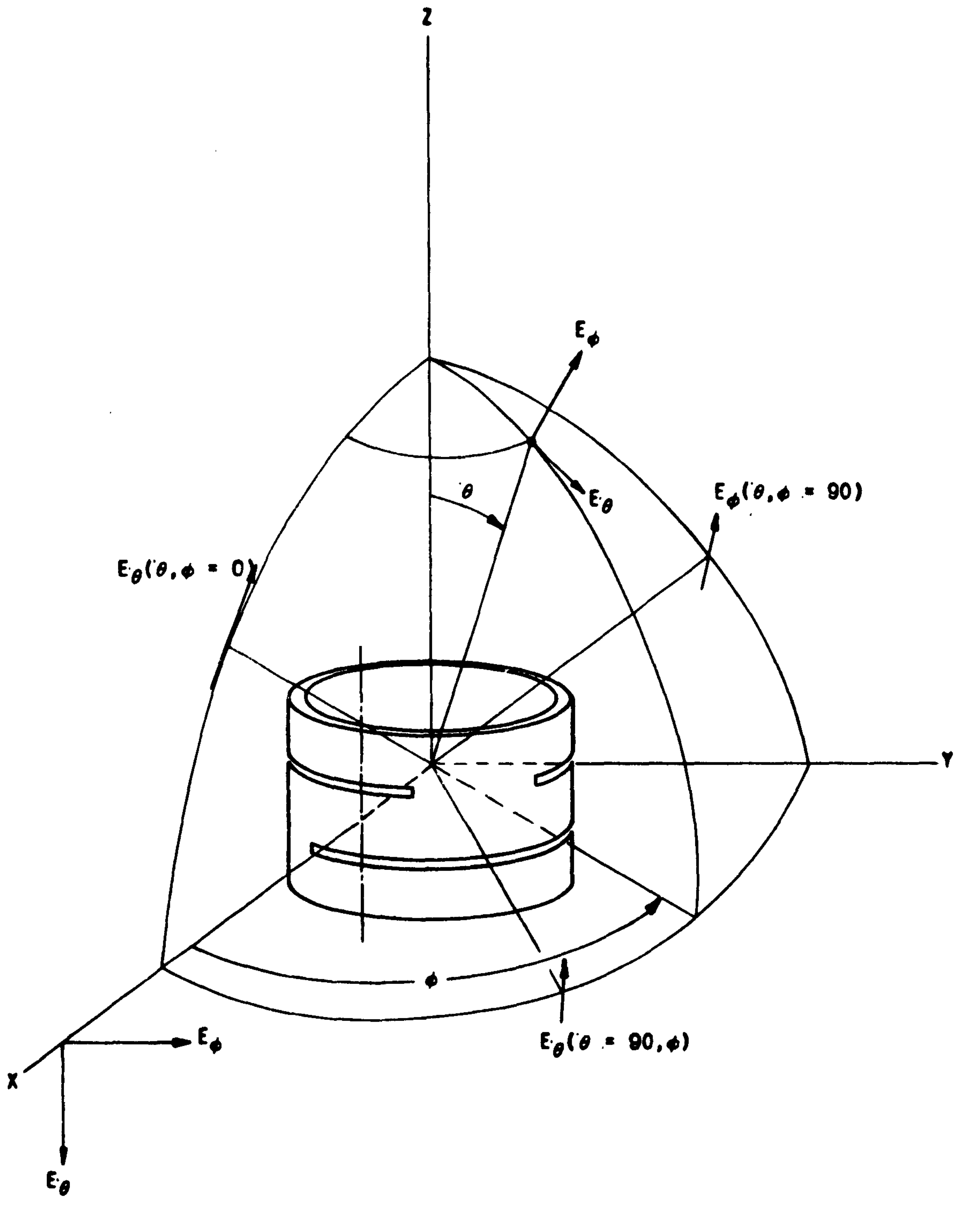



FIG. 20 COORDINATE SYSTEM FOR CIRCUMFERENTIALLY-SLOTTED CYLINDER ANTENNA

POLAR CHART

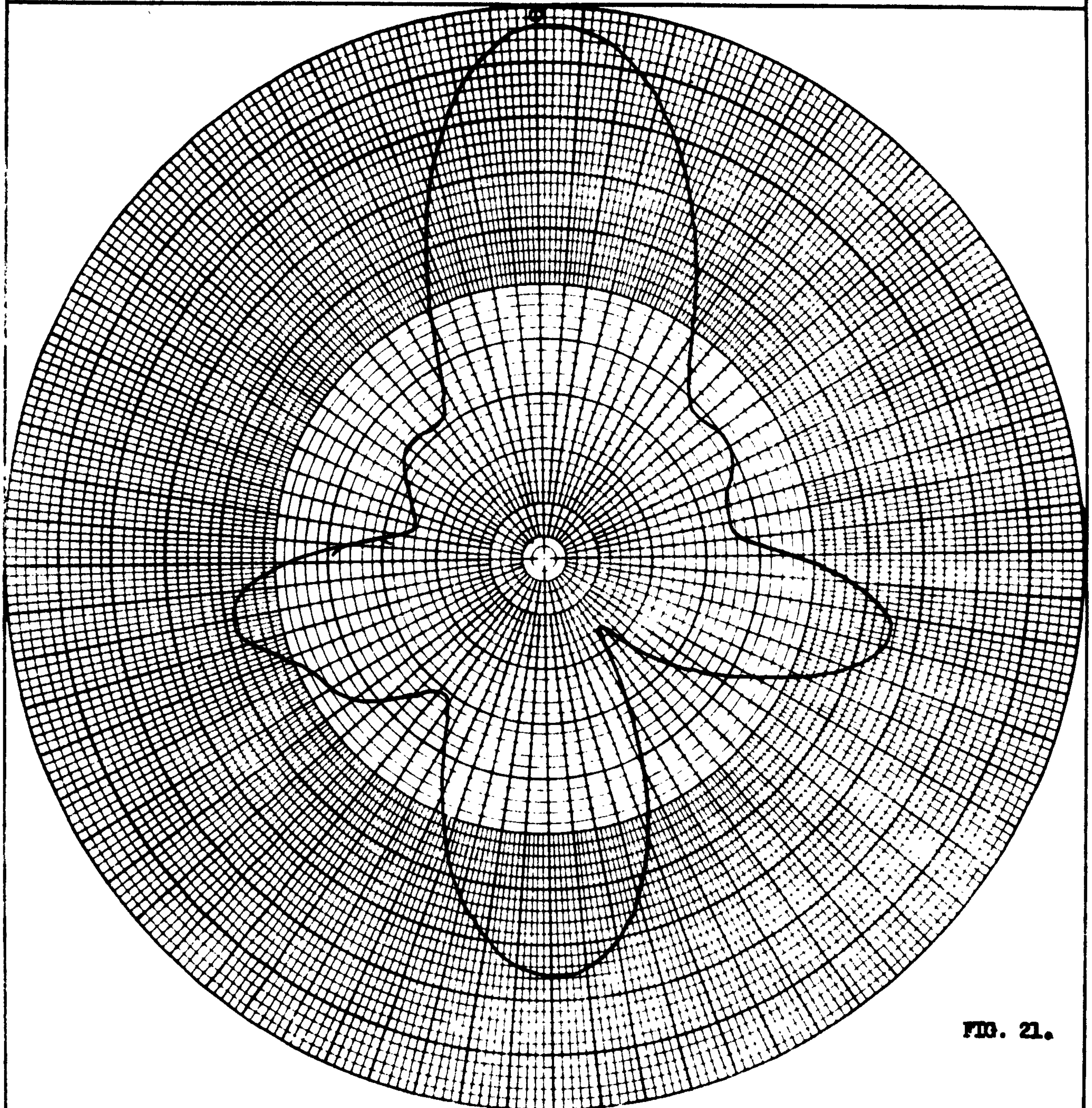
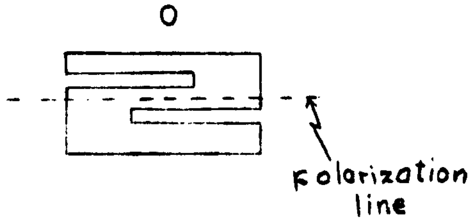


FIG. 21.

DIAGRAM




| | | |
|---|---|---|
| MODEL: CIRCUMFERENTIALLY-SLOTTED CYLINDER ANTENNA | | |
| ACTUAL FREQ (MC/S) 1690 | SCALE FREQ (MC/S) | COMPONENT $E_\theta(\theta, \phi = 0)$ |
| REMARKS 26 | | |
| DATE | NR. | TASK NR. |

## POLAR CHART

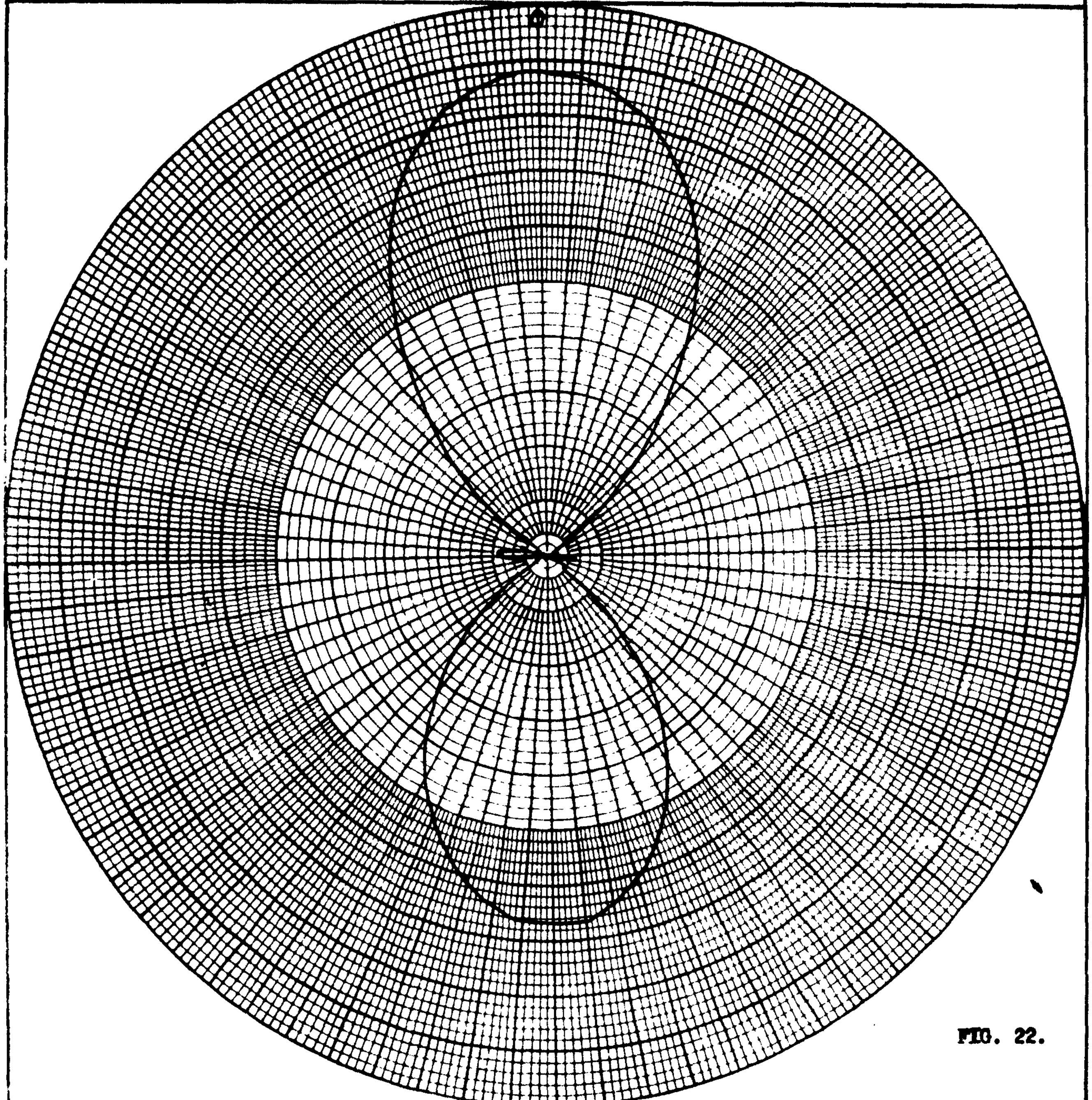
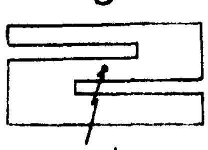


FIG. 22.

**DIAGRAM**

O



polarization line
out of paper

| MODEL | CIRCUMFERENTIALLY-SLOTTED CYLINDER ANTENNA | |
|---|---|---|
| ACTUAL FREQ (MC/S) | SCALE FREQ (MC/S) | COMPONENT |
| 1690 | | $E_\phi(\theta, \phi = 90)$ $E_\theta$ |
| REMARKS | | |
| DATE 27 | NR. | TASK NR. |

POLAR CHART

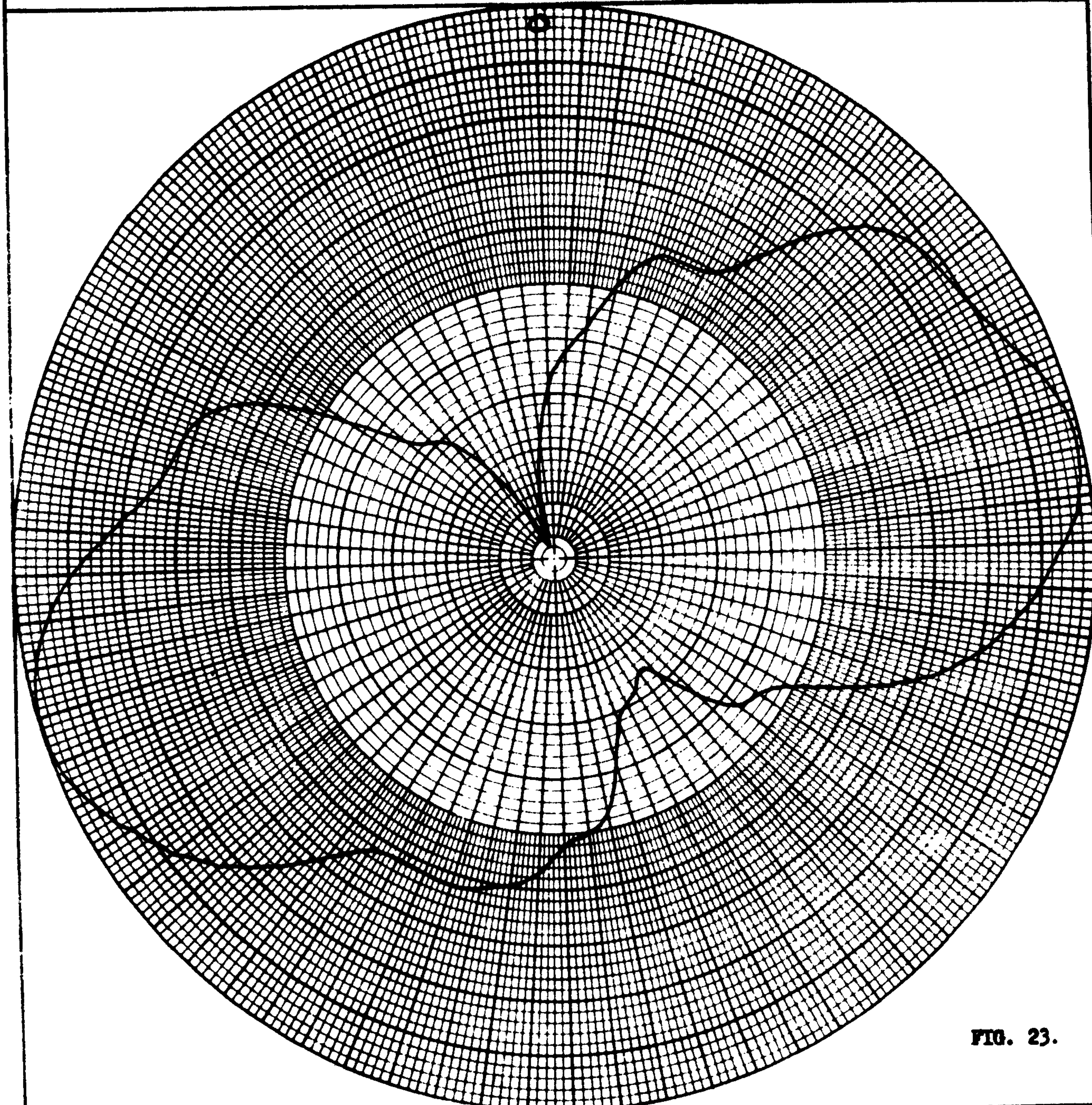
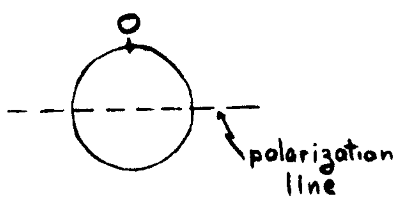



FIG. 23.

DIAGRAM




| MODEL | CIRCUMFERENTIALLY-SLOTTED CYLINDER ANTENNA | | |
|---|---|---|---|
| ACTUAL FREQ (MC/S) | SCALE FREQ (MC/S) | COMPONENT | |
| 1690 | | E $\phi$ | $E_\theta(\theta=90,\phi)$ |
| REMARKS | | | |
| DATE 28 | NR. | TASK NR. | |

POLAR CHART

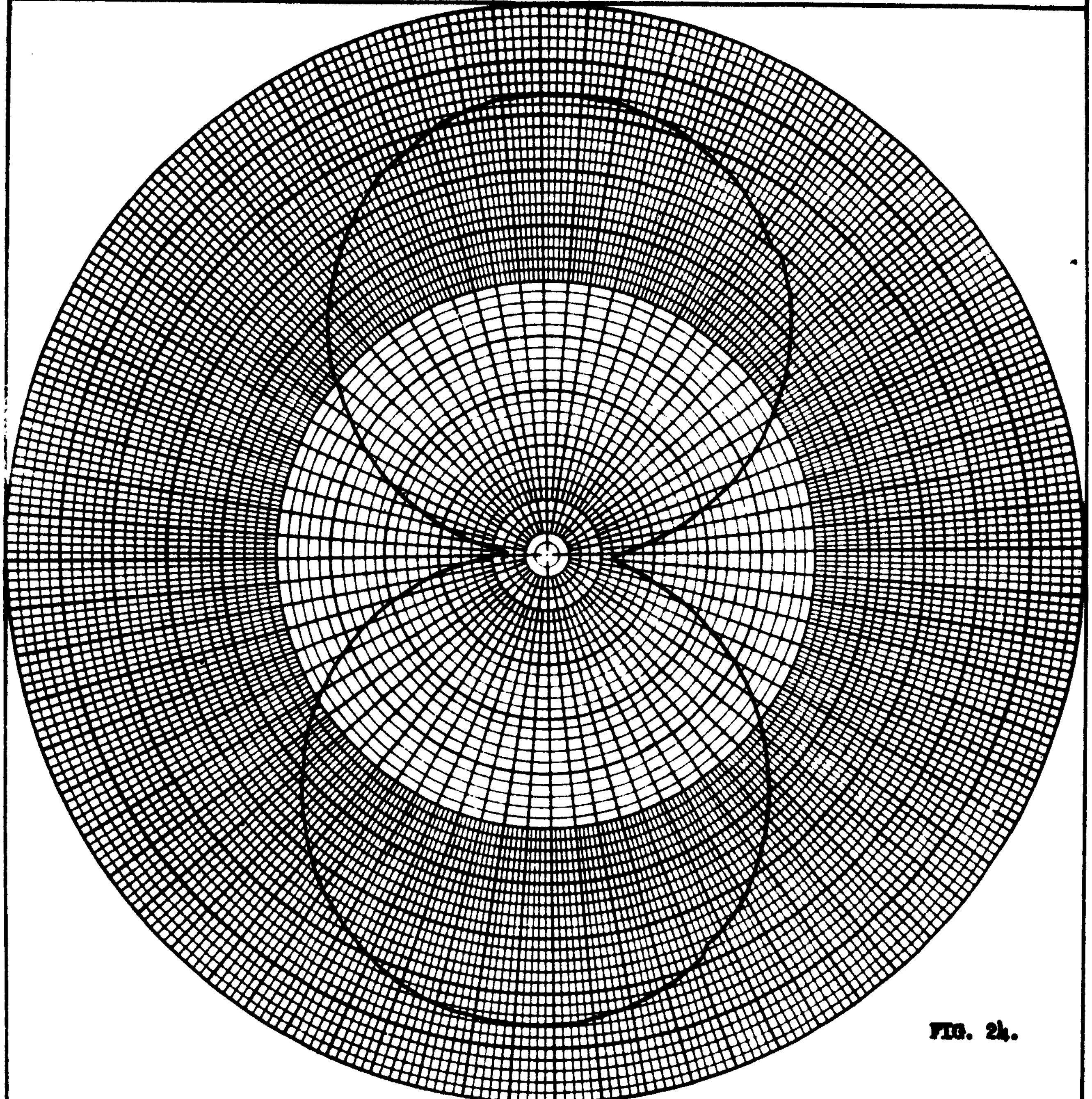
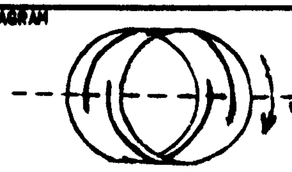


FIG. 24.

DIAGRAM




Orientation of polarization line for maximum intensity

| | | | |
|---|---|---|---|
| MODEL CIRCUMFERENTIALLY-SLOTTED CYLINDER ANTENNA | | | |
| ACTUAL FREQ (MC/S) 1690 | SCALE FREQ (MC/S) | COMPONENT E $\phi$ | E $\theta$ |
| REMARKS Polarization Pattern Receiver Horizontally Polarized | | | |
| DATE 29 | NR. | TASK NR. | |

FMSC Form 1 Aug 58 8627 (Replaces EL-SC Form 634 which may be used)

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## POLAR CHART

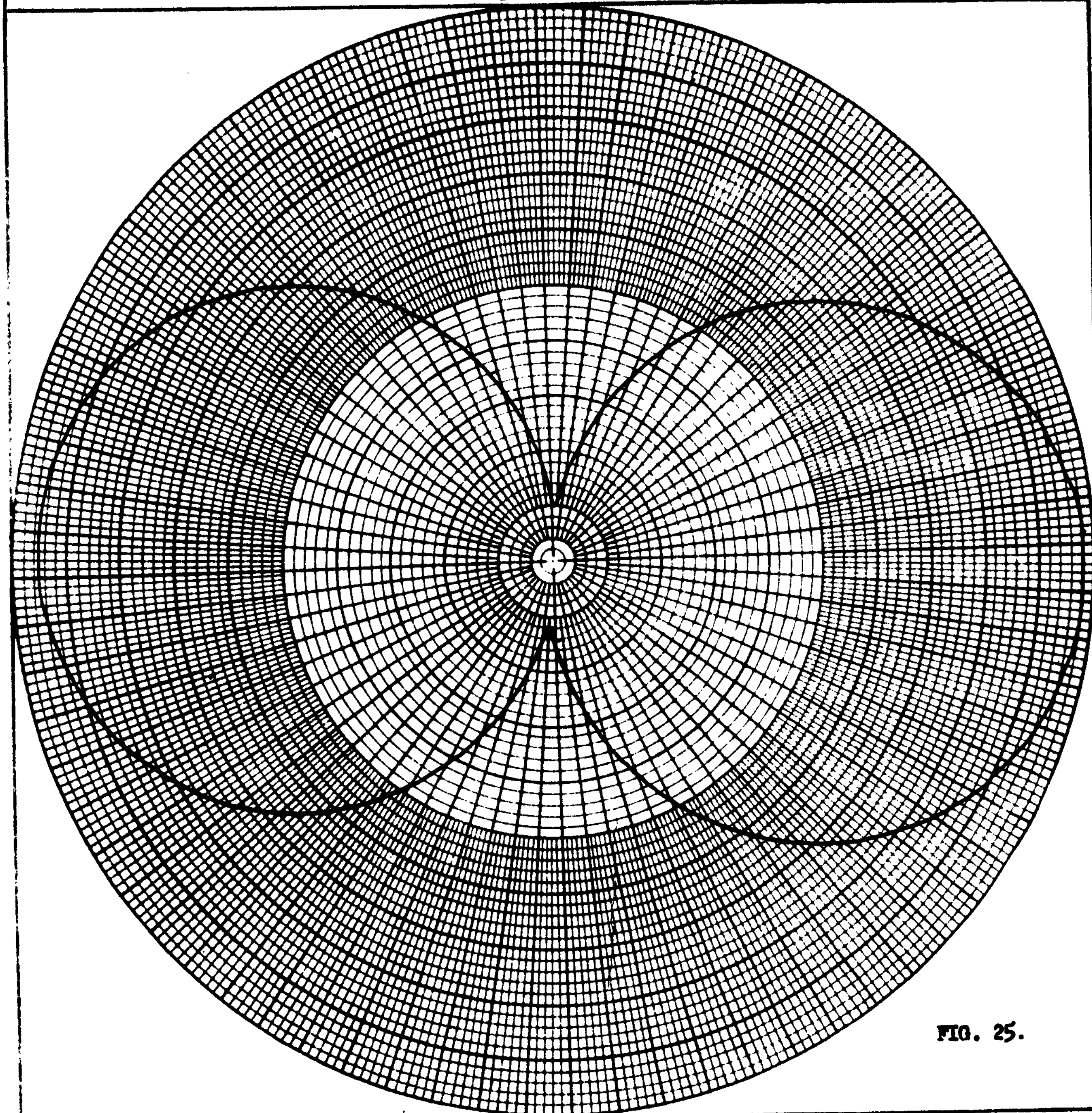
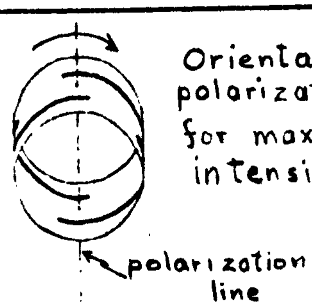


FIG. 25.

DIAGRAM




Orientation of polarization line for maximum intensity

| | | | |
|---|---|---|---|
| MODEL CIRCUMFERENTIALLY-SLOTTED CYLINDER ANTENNA | | | |
| ACTUAL FREQ (MC/S) 1690 | SCALE FREQ (MC/S) | COMPONENT E $\phi$ | E $\theta$ |
| REMARKS Polarization Pattern Receiver Vertically Polarized | | | |
| DATE 30 | NR. | TASK NR. | |

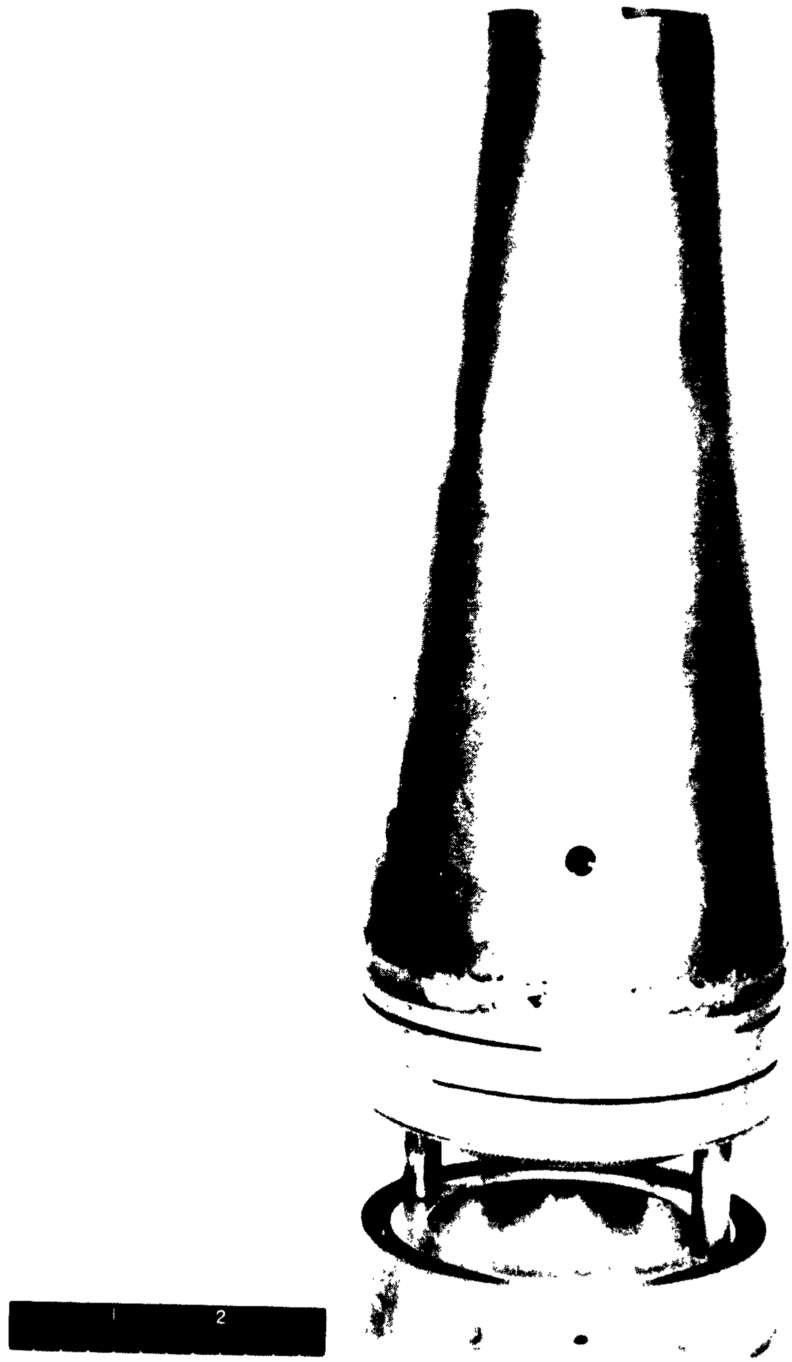


FIG. 26. CIRCUMFERENTIALLY-SLOTTED CYLINDER ANTENNA MOUNTED ON MOCK-UP OF RADIOSONDE SET AN/DMQ-6

POLAR CHART

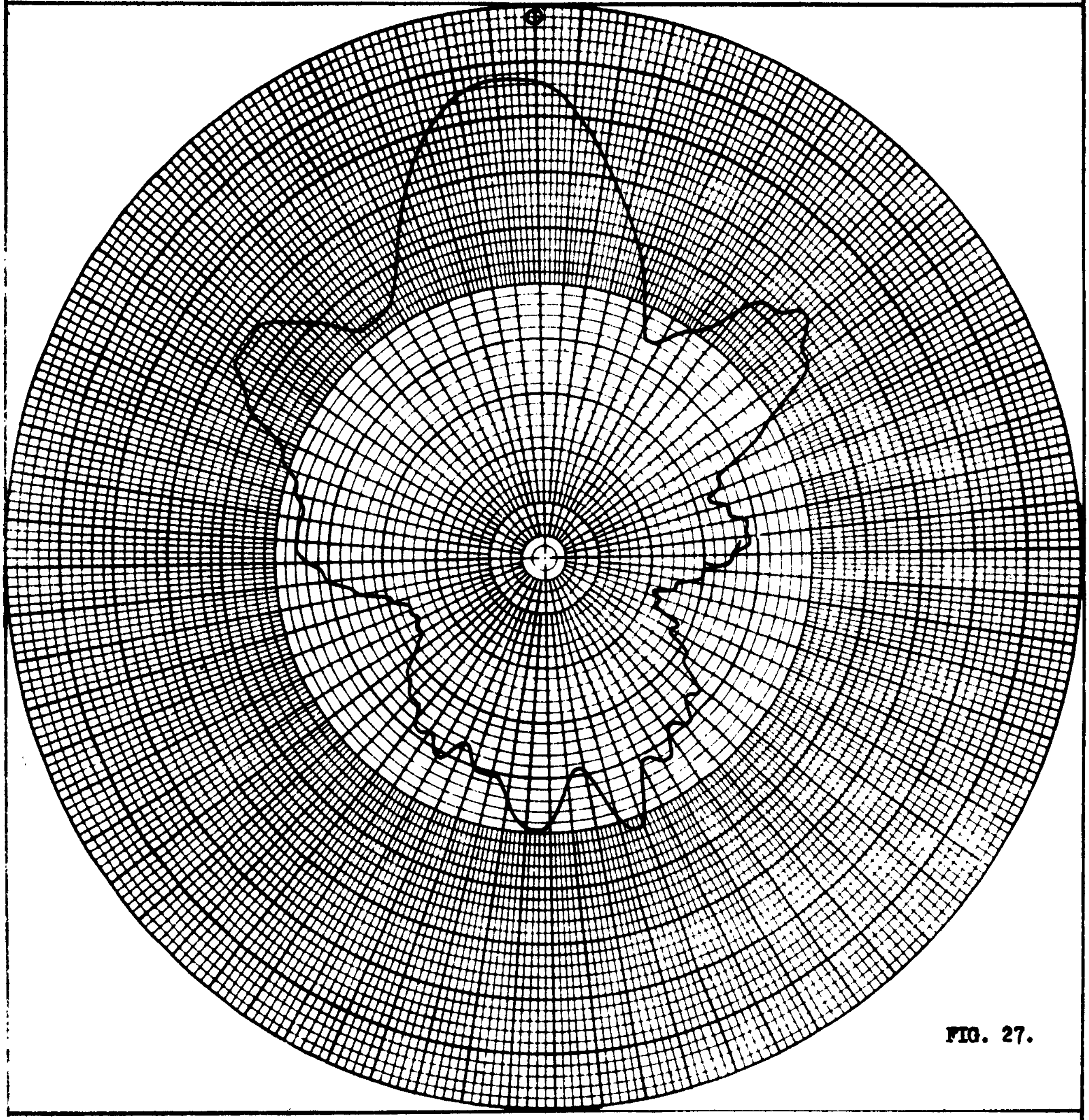


FIG. 27.

**CIRCUMFERENTIALLY-SLOTTED CYLINDER ANTENNA, MOUNTED ON ARCAS ROCKET**

| ACTUAL FREQ (MC/S) | SCALE FREQ (MC/S) | COMPONENT | |
|---|---|---|---|
| | | E $\phi$ | $E_\theta(\theta, \phi = 0)$ |

REMARKS

**Compare with Figure 21.**

32

| DATE | NR. | TASK NR. |
|---|---|---|
| | | |

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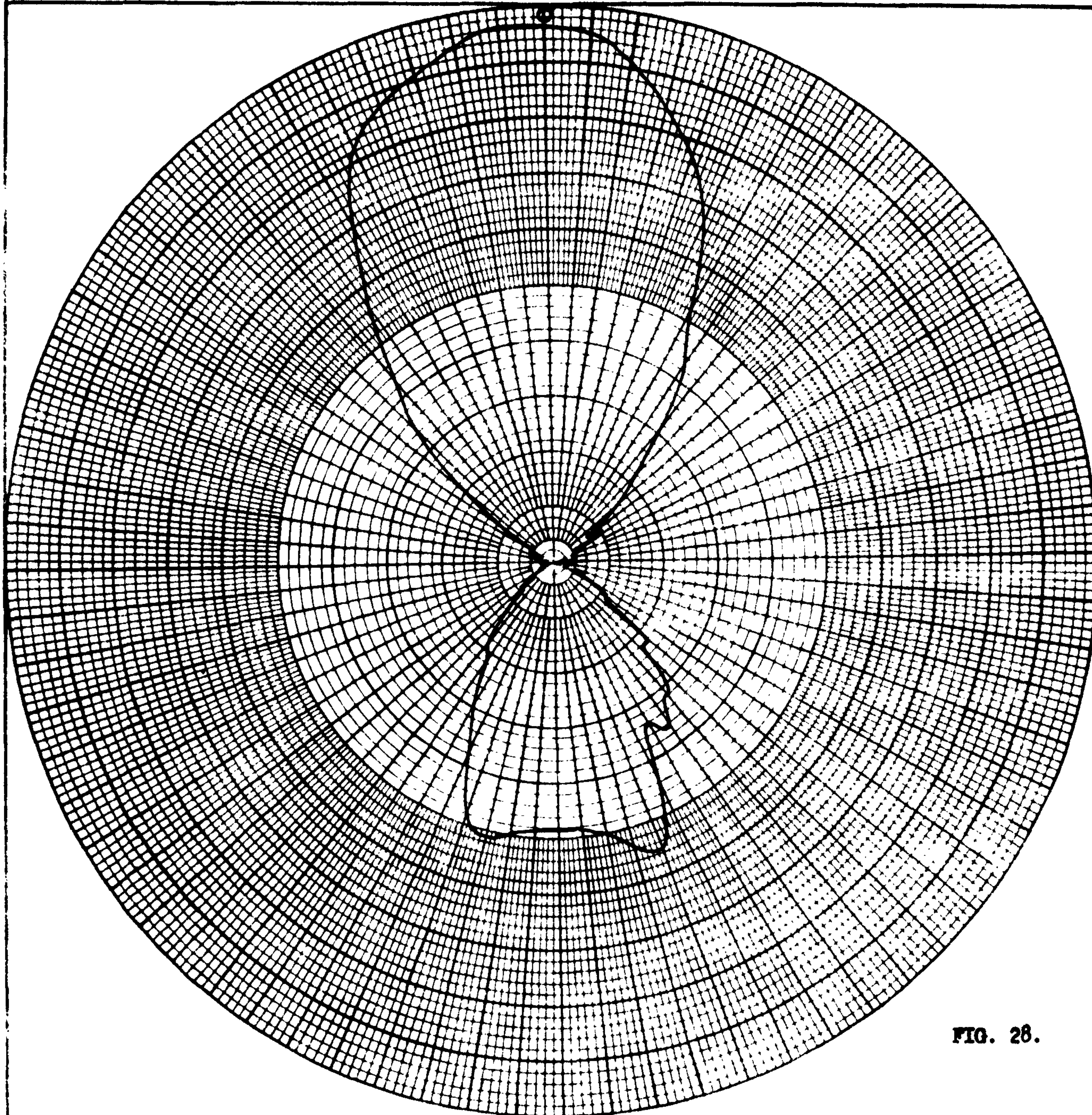


FIG. 28.

**CIRCUMFERENTIALLY-SLOTTED CYLINDER ANTENNA, MOUNTED ON ARCAS ROCKET**

| ACTUAL FREQ (MC/S) | SCALE FREQ (MC/S) | COMPONENT |
|---|---|---|
| 1690 | | $E_\phi(\theta, \phi = 90)$ E |

REMARKS

**Compare with Figure 22.**



| DATE | NR. | TASK NR. |
|---|---|---|
| | | |

APPENDIX I

CONSTRUCTION DETAILS OF HELICALLY SLOTTED CYLINDER ANTENNA

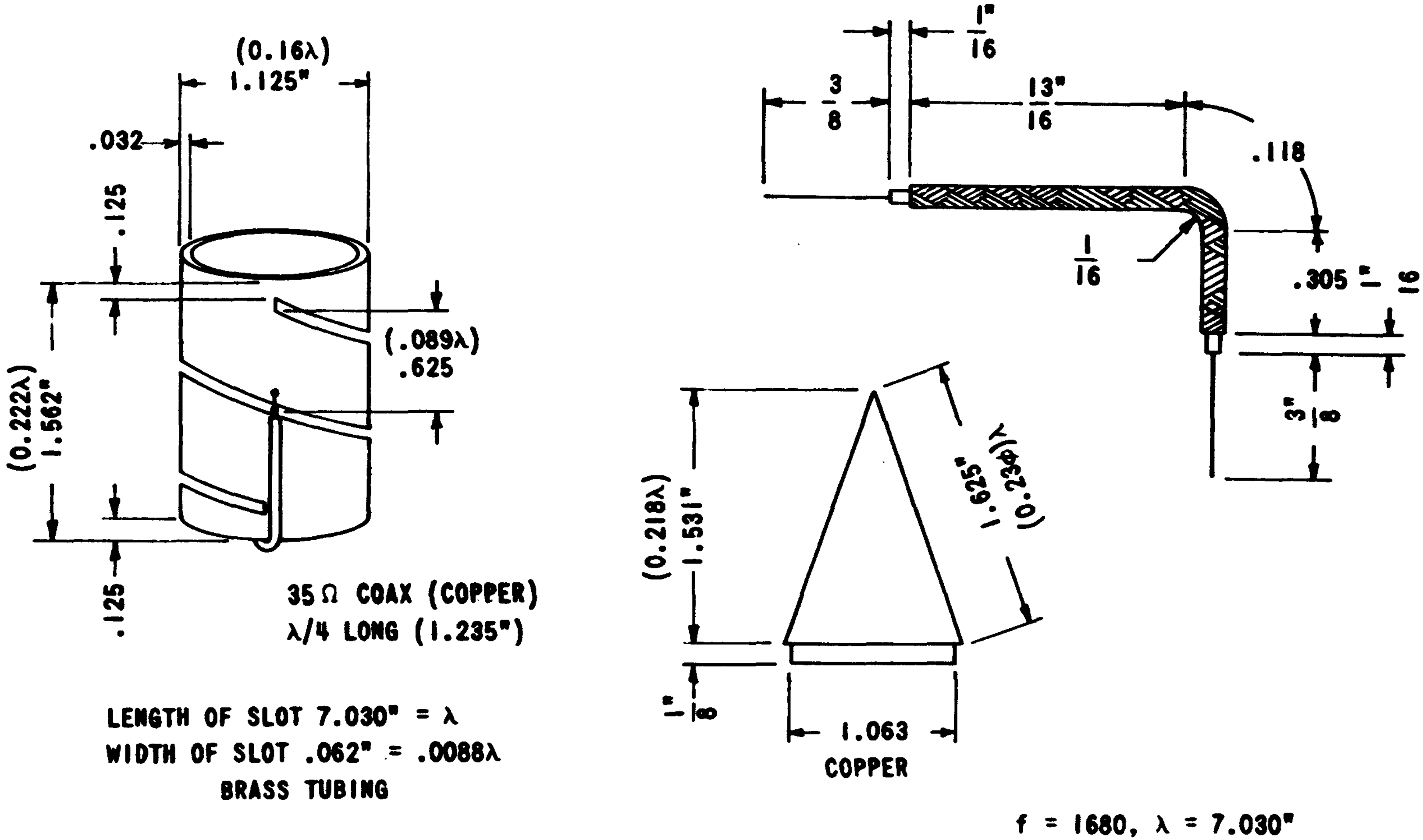



FIG. I.1. DIMENSIONS OF COMPONENTS

APPENDIX I (Contd.)

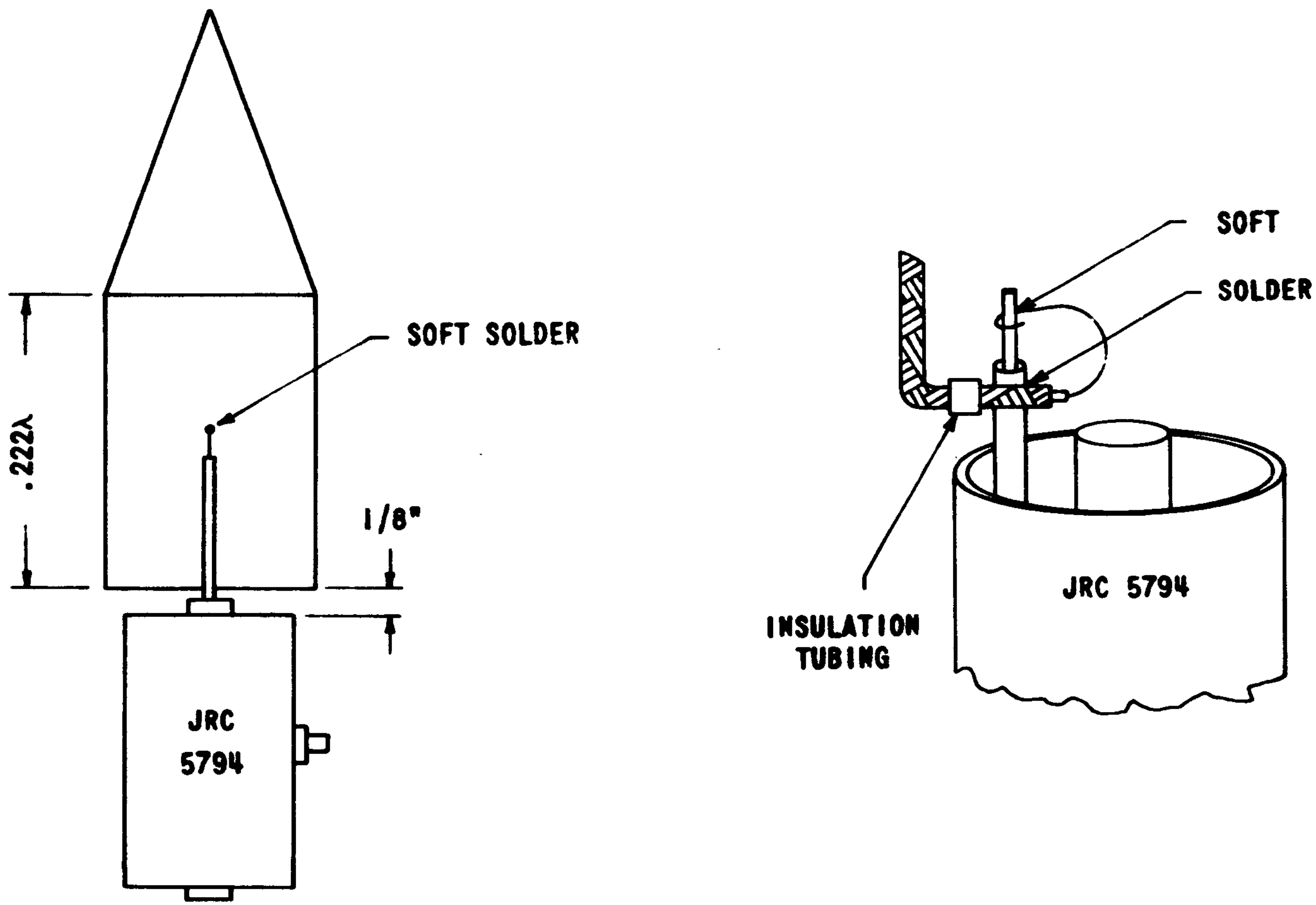



FIG. I.2. CONNECTIONS TO JRC 5794 TUBE

## APPENDIX II

### CONSTRUCTION DETAILS OF CIRCUMFERENTIALLY-SLOTTED CYLINDER ANTENNA

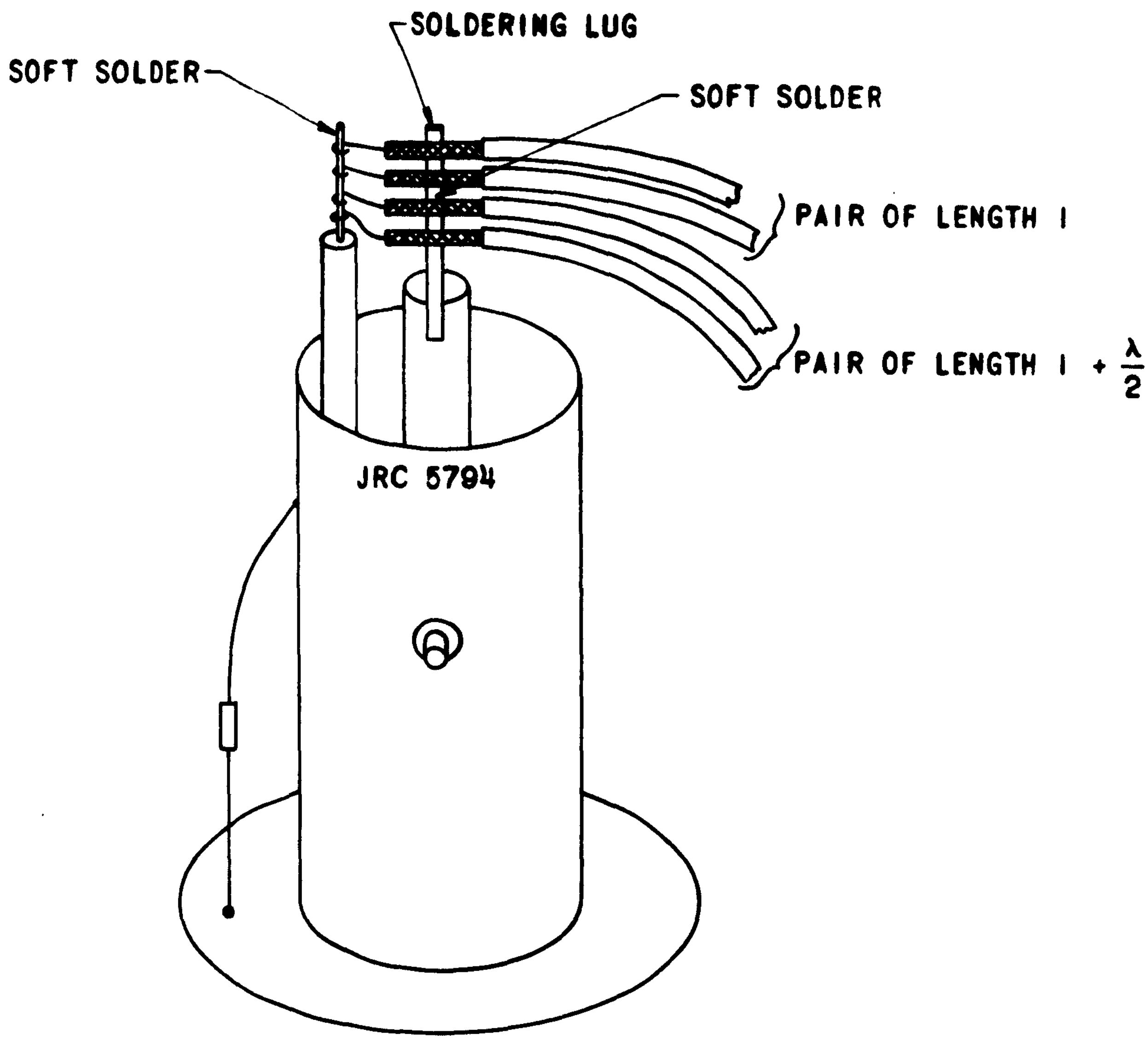
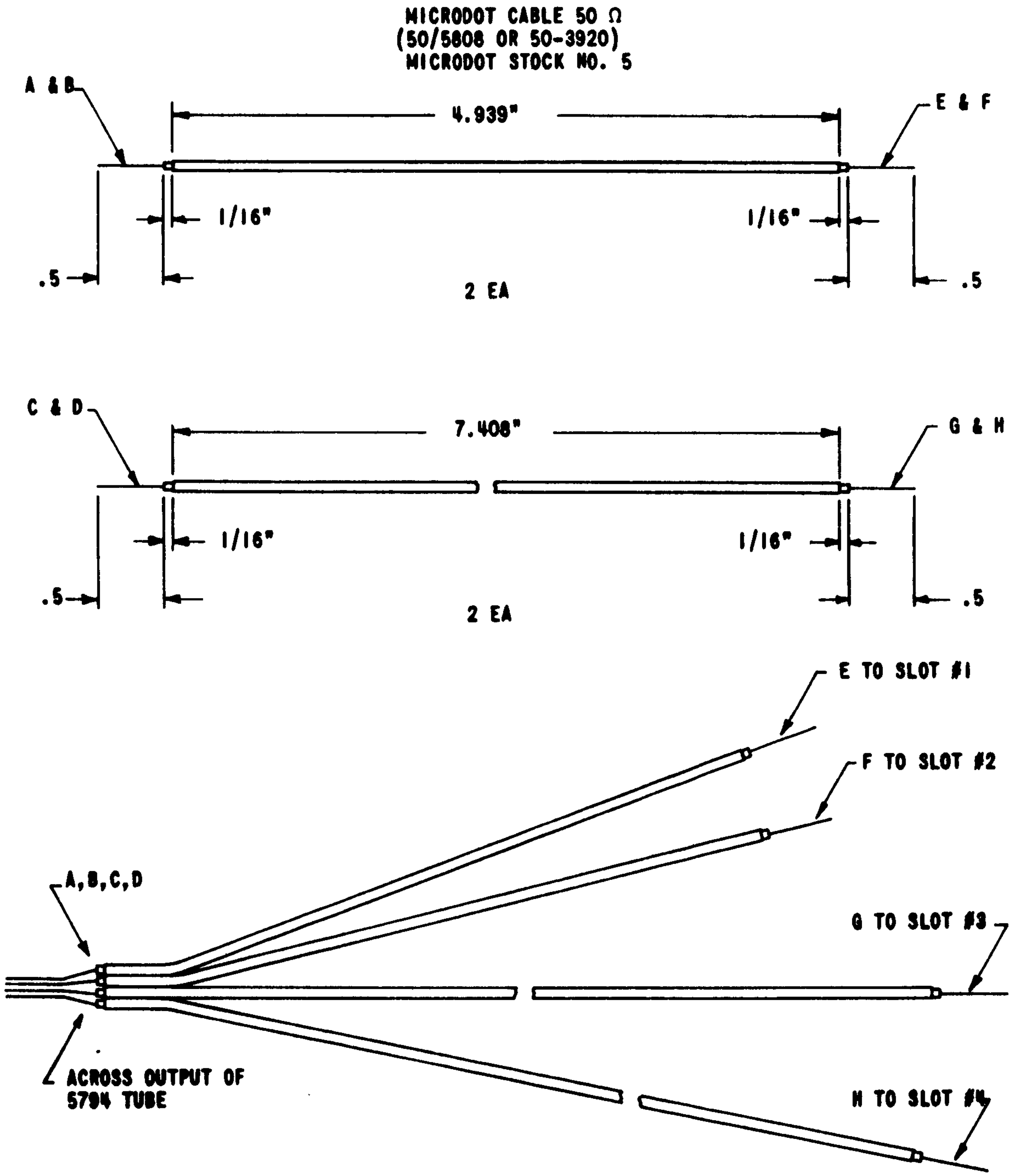



FIG. II.1. FEED CABLE TO TUBE CONNECTION




E,F,G & H ARE SOLDERED ACROSS SLOTS 1,2,3 & 4 IN THE SAME DIRECTION IN ORDER TO RETAIN DESIRED PHASE RELATION OF OUTPUT SIGNAL.

FIG. II.2. DIMENSIONS OF FEED CABLES

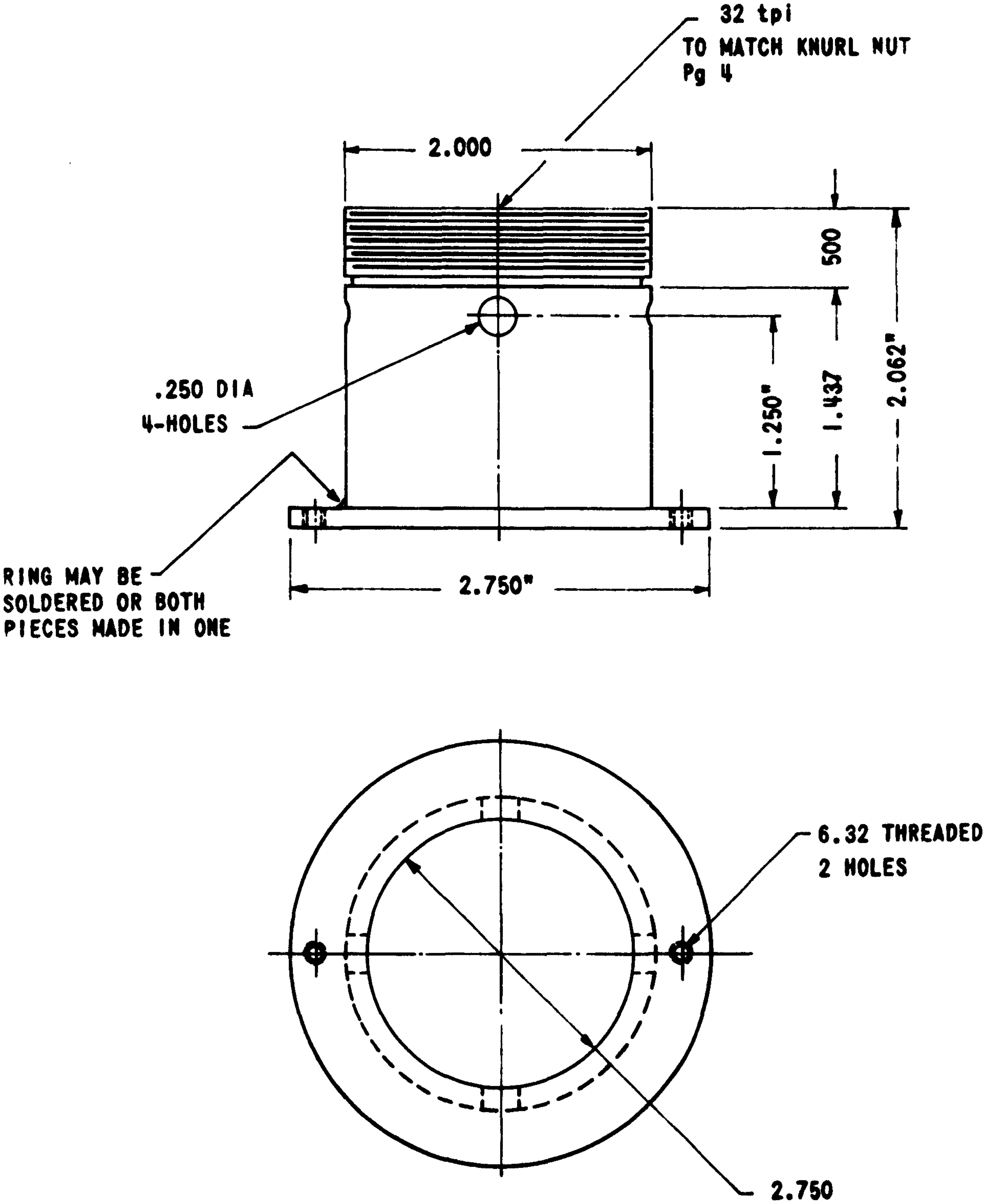



FIG. II.3. INNER SLEEVE

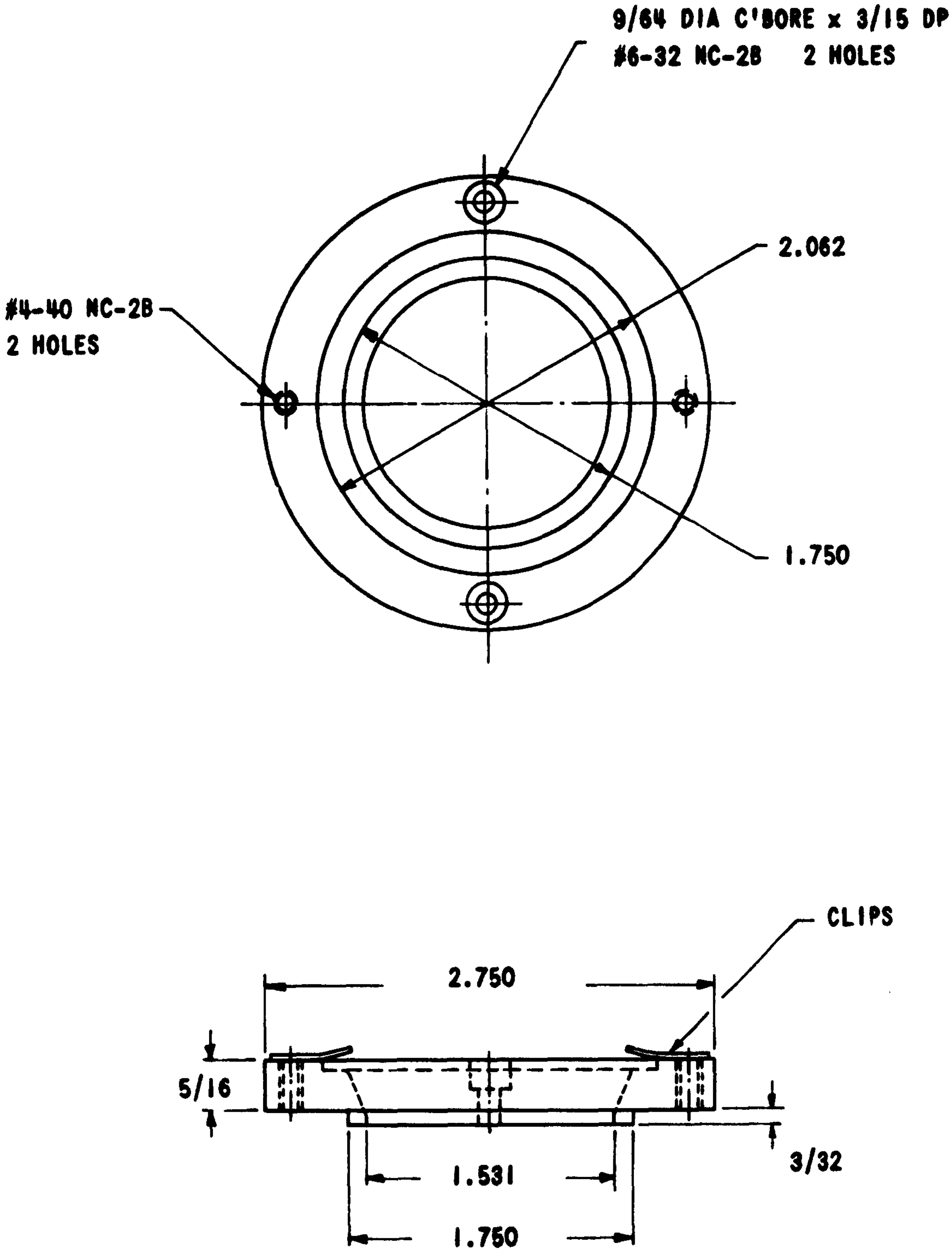



FIG. II.4. TUBE MOUNTING

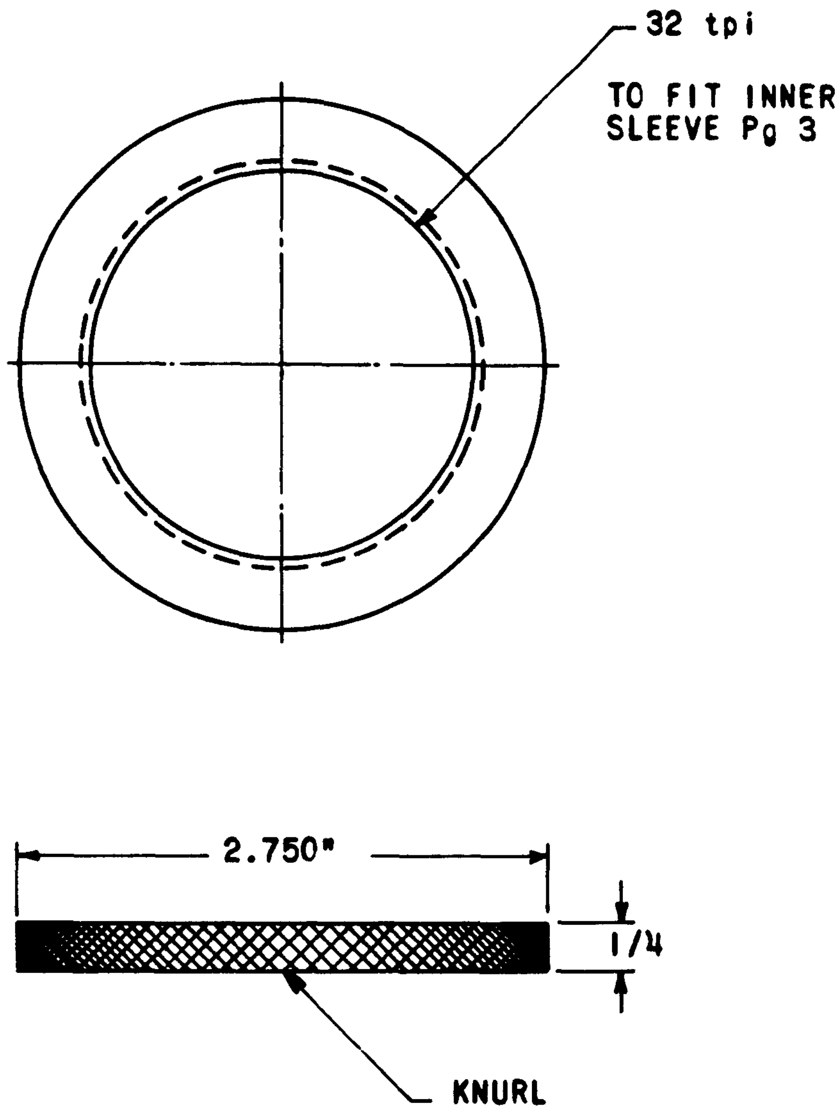
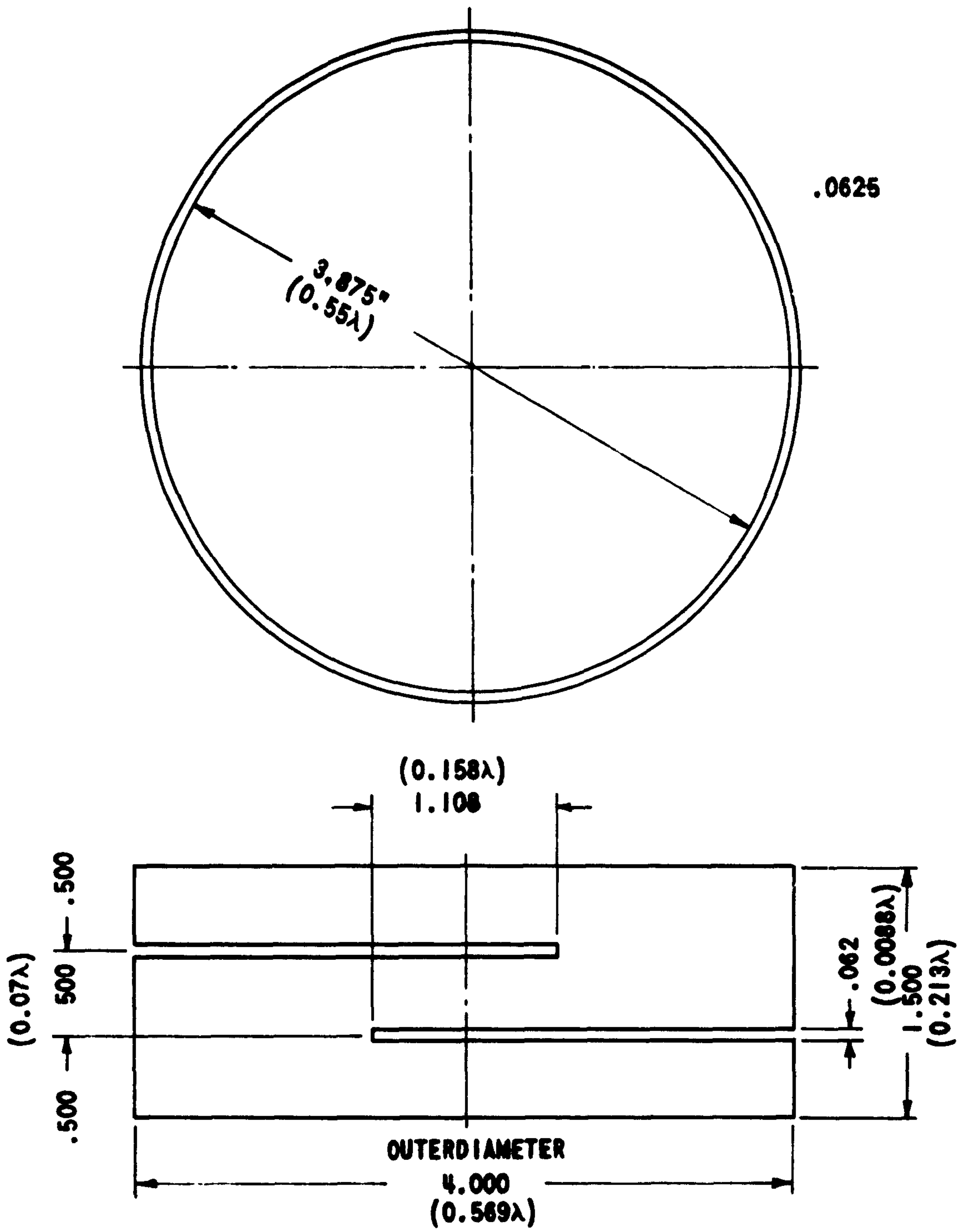



FIG. II.5. RING FASTENER




f = 1680 λ = 7.030 inches

SLOT LENGTH = 4.250" ON OUTSIDE CIRCUMFERENCE = .6λ
OVERLAP ON ADJACENT SLOTS 1.108"

FIG. II.6. CIRCUMFERENTIALLY-SLOTTED CYLINDER

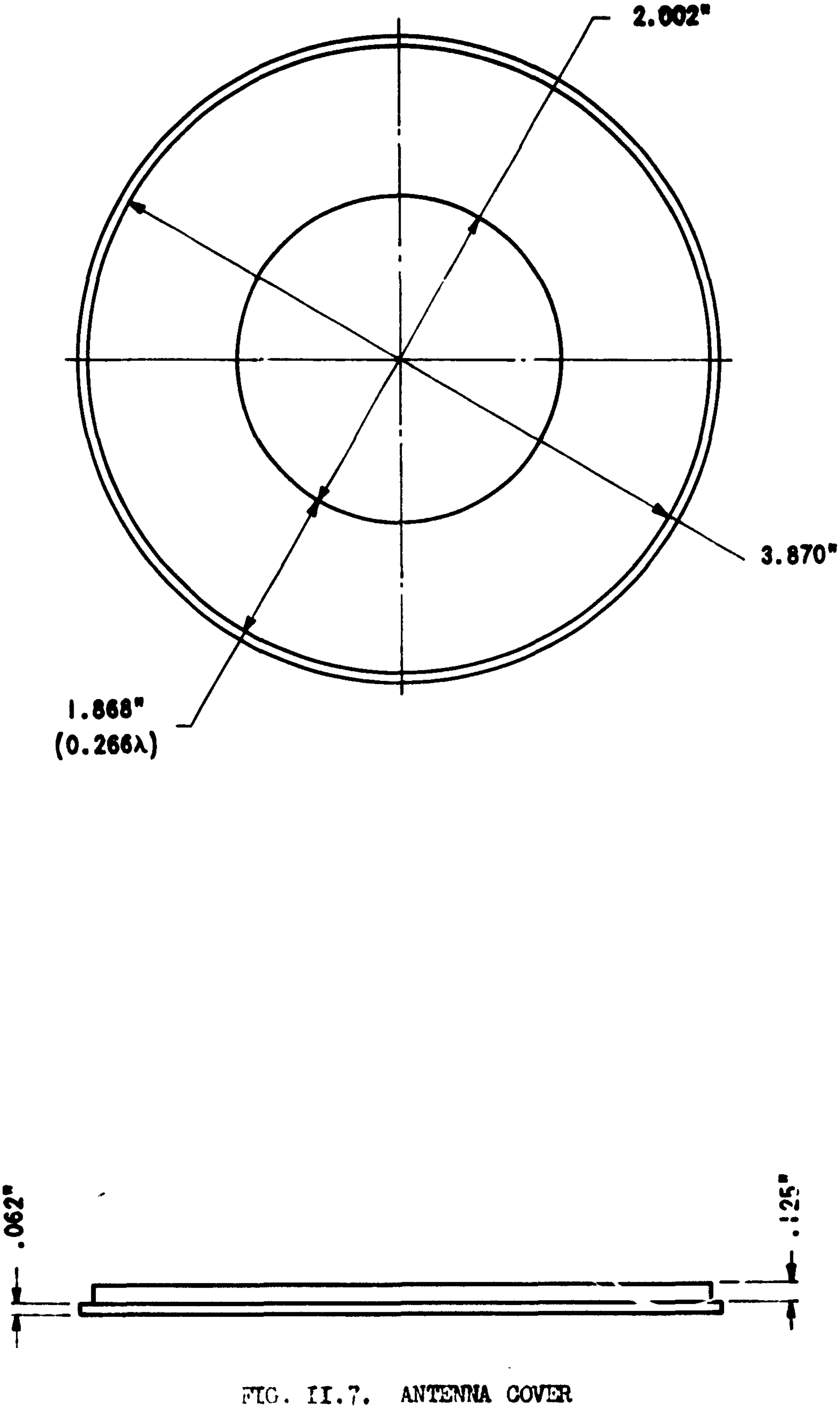



FIG. II.7. ANTENNA COVER

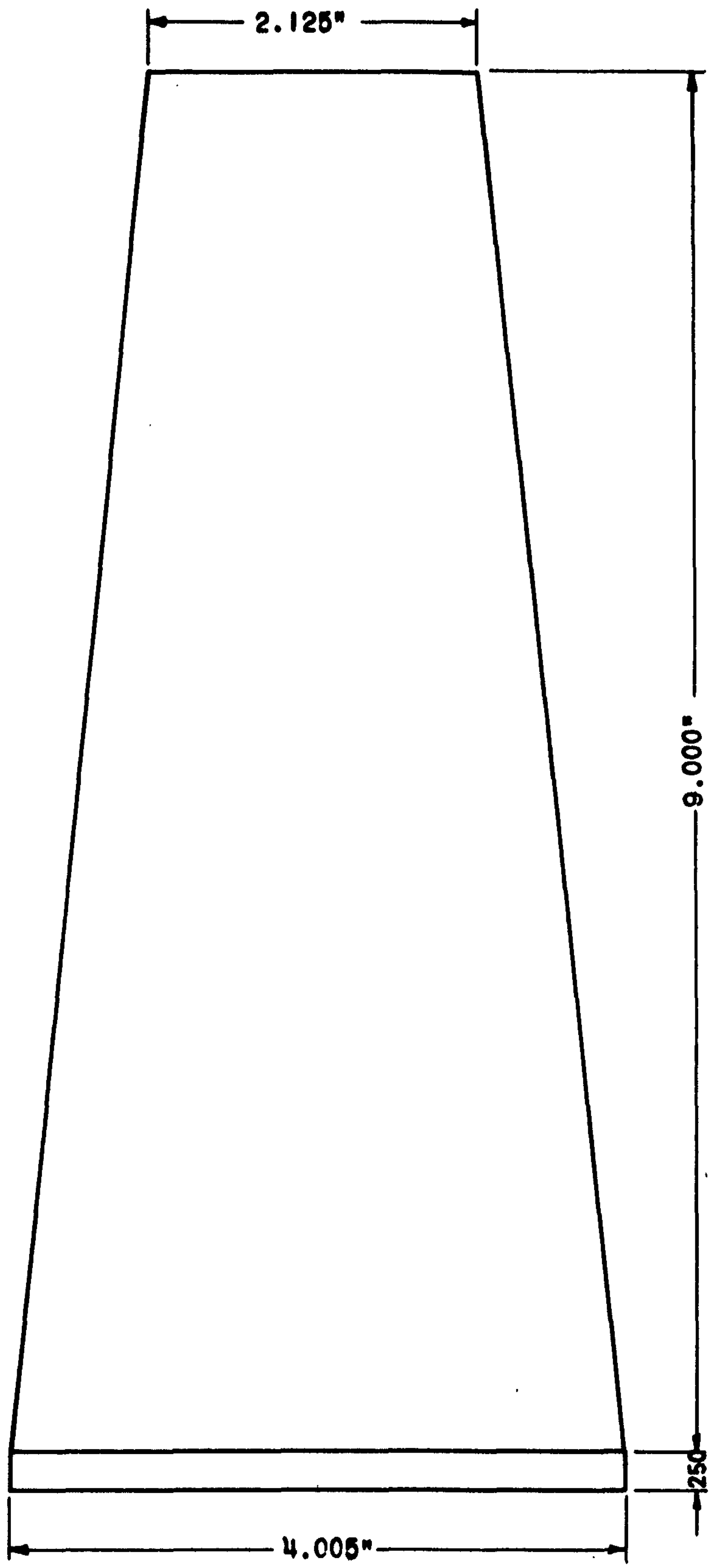



FIG. II.8. CONICAL GROUND PLANE

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(USAELRDL Technical Report 2368)
(DA Task 1-G-6-20801-A-037-01)
Unclassified Report

Rocket-borne Radiosonde Set AN/DMQ-6 requires a compact, omnidirectional antenna with good axial coverage to permit tracking of the rocket nose cone on descent as well as ascent. A helical slotted cylinder antenna, compact enough to fit into the nose cone of the ARCAS rocket and with operation in the 1660-1700 mc frequency range, was developed to meet this requirement. A second requirement, arising from the need to use the entire upper portion of the nose cone for sensory equipment, was satisfied by development of a circumferentially slotted cylinder antenna. Both antennas proved satisfactory in engineering flight tests. They can also serve in other rocket applications where good axial coverage is desired. The significant result of this investigation is the development of antennas of small length and diameter having linearly polarized radiation fields along their axes.

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2. Slotted Cylinders
3. Rocket Radiosonde

I. Thompson, Stafford W. and Farley, Elza R.
II. Army Electronics Research and Development Laboratory, Fort Monmouth, N. J.
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