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STREAMLINED MICROWAVE OMNI-DIRECTIONAL ANTENNAS

REPORT
871

RADIATION LABORATORY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
CAMBRIDGE · MASSACHUSETTS

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Div. 14
OEMsr-262

Radiation Laboratory

Report 871 January 8, 1946

SUPERSONIC MICROWAVE OMNI-DIRECTIONAL ANTENNAS

Abstract

High speed aircraft require antennas which are inherently streamlined. Details are given of antennas for both horizontal and vertical polarization at S-band. For horizontal polarization a pair of slots on the flat faces of a streamlined section give excellent results when fed by a slotted dipole. For vertical polarization a pair of vertical dipoles may be used. The designs are such as to provide satisfactory azimuth and elevation patterns with tolerable match.

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W. J. Riblet

Approved by: [signature]
Leader, Group 54

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Head, Division 5

Title page
2 Numbered Pages
1 Bibliography
9 Pages of Figures

STREAMLINED MICROWAVE OMNI-DIRECTIONAL ANTENNAS

In previous reports, [1,2,3] one of the writers has described microwave omni-directional antennas for both horizontal and vertical polarization. These have all depended for their uniformity of pattern on a certain azimuthal symmetry. In particular, the outer extent of these antennas has been circular. The success of S and X-band ground radars has raised to considerble importence the problem of designing suitable omnidirectional antennas which can be installed on military aircraft for identification and communication purposes. Although the use of very fast planes puts a great premium on flush antennas, the performance of the radars has often been so critical that satisfactory results can be hoped for, only if the antenna is mounted clear and free of the aircraft. One can try simply to use streamlined covers on the antenna types described in the above reports, but unfortunately these are of such a size that the resulting side loads present very serious, if not impossible, mechanical problems. It is clear then that, for satisfactory solution of these problems, antenna forms which lend themselves to streamlining, i. e., have one very narrow dimension, are necessary. We have found it possible to get very satisfactory performance from antennas of this type for both horizontal and vertical polarization.

A. Horizontally Polarized Antennas at S-band.

Fig's 1 and 2 show two versions of a scheme which will give satisfactory performance for a horizontally polarized beacon antenna at S-band. The basic fact governing the operations of these antennae is that a pair of slots centrally cut in the opposite sides of a thin waveguide when excited 180° out of phase has a nearly uniform azimuthal pattern. These slots may be excited either by probes extending into the guide or by means of the slotted dipole shown in the figures 1 and 2. The advantages of this latter procedure are at least two in number. Feeding power from a cable is very simple and considerable space is available in the structure for feeding other antennas. Fig. 3 gives the azimuthal pattern for both the whole and half slot antenna. The elevation patterns of the two antennas are shown in Fig. 4. Fig. 5 shows the SWR over a band for the two different types.

The antenna of Fig. 2 was constructed from that of Fig. 1 by cutting off the upper half of the cavity. Then, in order to surpress direct radiation from the remainder of the cavity, two straps shown in the figure were added. This had the desired effect, although the elevation beam width is somewhat wider than that of the full slot antenna.

B. Vertically Polarized Antennas at S-band.

Fig's 6 & 7 show two slightly different versions of antennae which are usable for vertical polarization. The difference between 6 and 7 is that the element in 7 is so constructed that two quarter inch coaxial lines can be run side by side making possible the construction of a combined transmitting and receiving antenna in a single unit.

The element used in the antenna of Fig. 6 is called the single line H element or just H-element while that of Fig. 7 is called the double line H element or simply double H-element. The azimuthal patterns of the two types are shown in Fig. 8. Fig. 9 gives the elevation patterns of 2 and 3 bay arrays of H elements. Since the double H elements were to be used singly but in close proximity, chokes or wave traps as shown in Fig. 7 were placed on both sides of the element as indicated in Fig. 10. These serve to reduce the cross talk between the transmitting and receiving antennas and to minimize the stray currents flowing on the feeder. An elevation pattern of a double H element with wave traps is given in Fig. 10. Fig. 11 gives the $(SWR)^2$ over a band of a two bay array of H-elements mounted as shown in Fig. 6. Preliminary measurements indicated that comparable bandwidth could be expected of the single double-H element with wave traps.

It will be observed perhaps that for none of these antennas are patterns shown over a frequency band. Although some of this data exists, it is nevertheless not complete, and when the war ended there seemed to be no good reason for getting it. The important fact is that in general, the requirements on SWR for these antennas will more quickly limit their usefulness than requirements on pattern.

C. B. Barker
H. J. Riblet
November 26, 1945

Bibliography

1. Radiation Laboratory Report, 517 S-Band Horizontally Polarized Non-directional Antennas, H. J. Riblet, February 14, 1944

2. Radiation Laboratory Report, 623 S-Band Vertically Polarized Non-directional Antennas, H. J. Riblet, December 20, 1944

3. Radiation Laboratory Report, 489 X-Band Horizontally Polarized Non-directional Antennas, H. J. Riblet, April 22, 1944

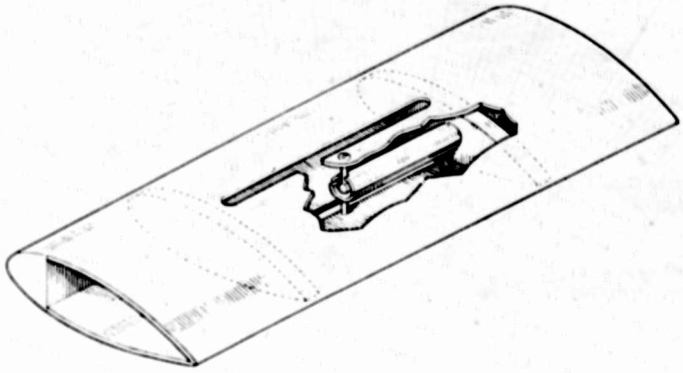

FIG. 1 FULL-SLOT ANTENNA S-BAND

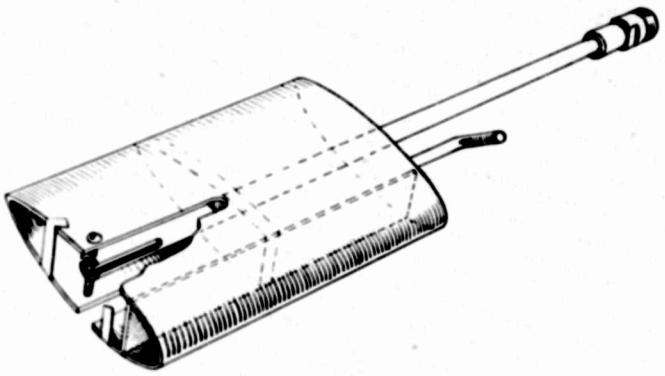

FIG. 2 HALF-SLOT ANTENNA S-BAND

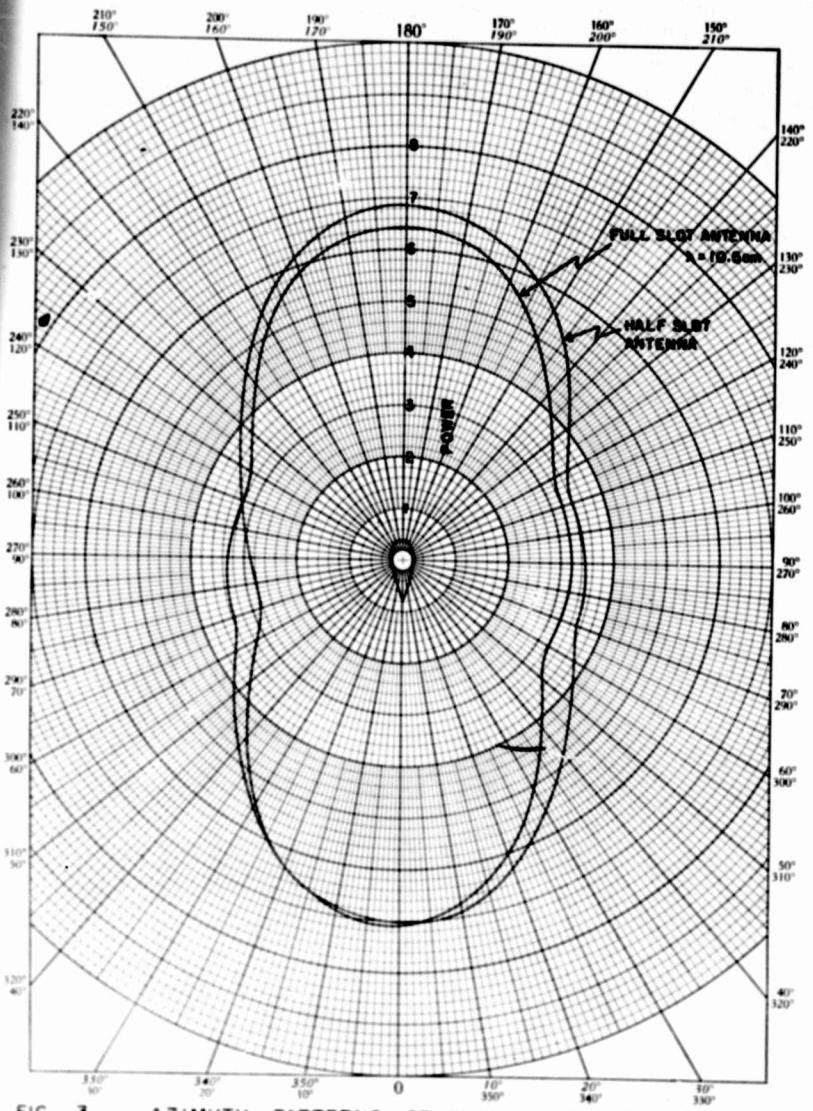

FIG. 3 — AZIMUTH PATTERNS OF SLOTTED BEACON ANTENNAS

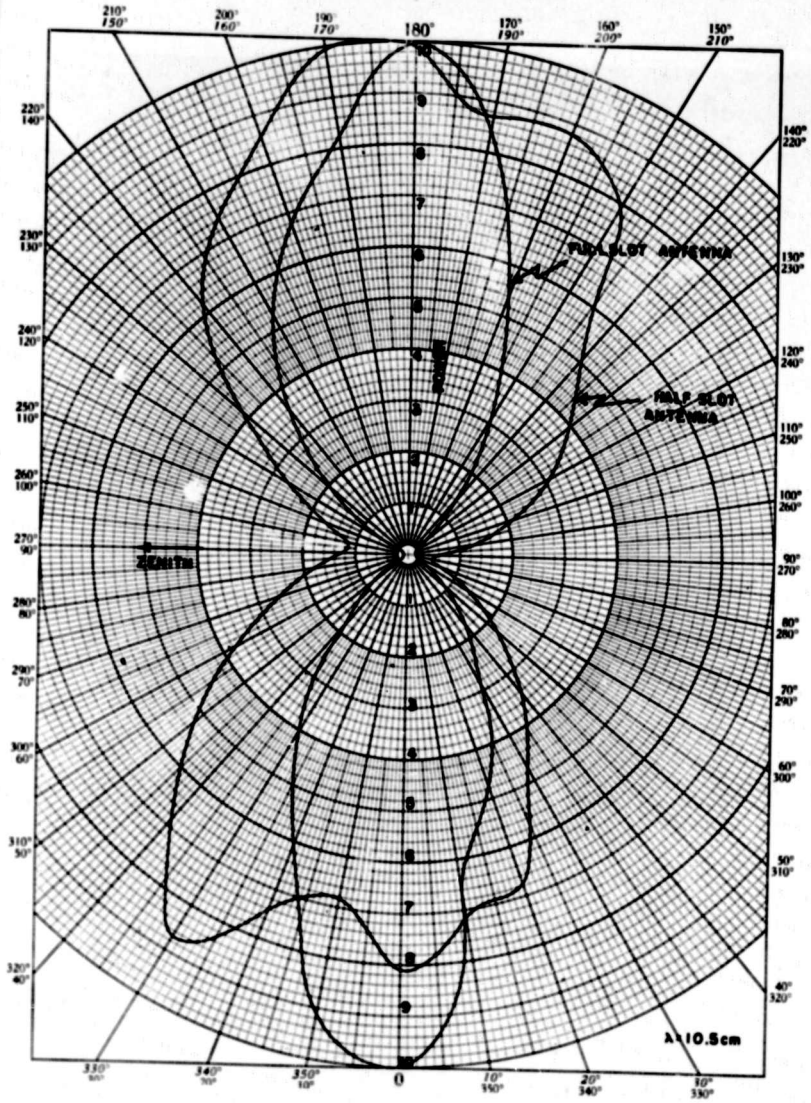

FIG. 4 – ELEVATION PATTERNS OF SLOTTED ANTENNAS

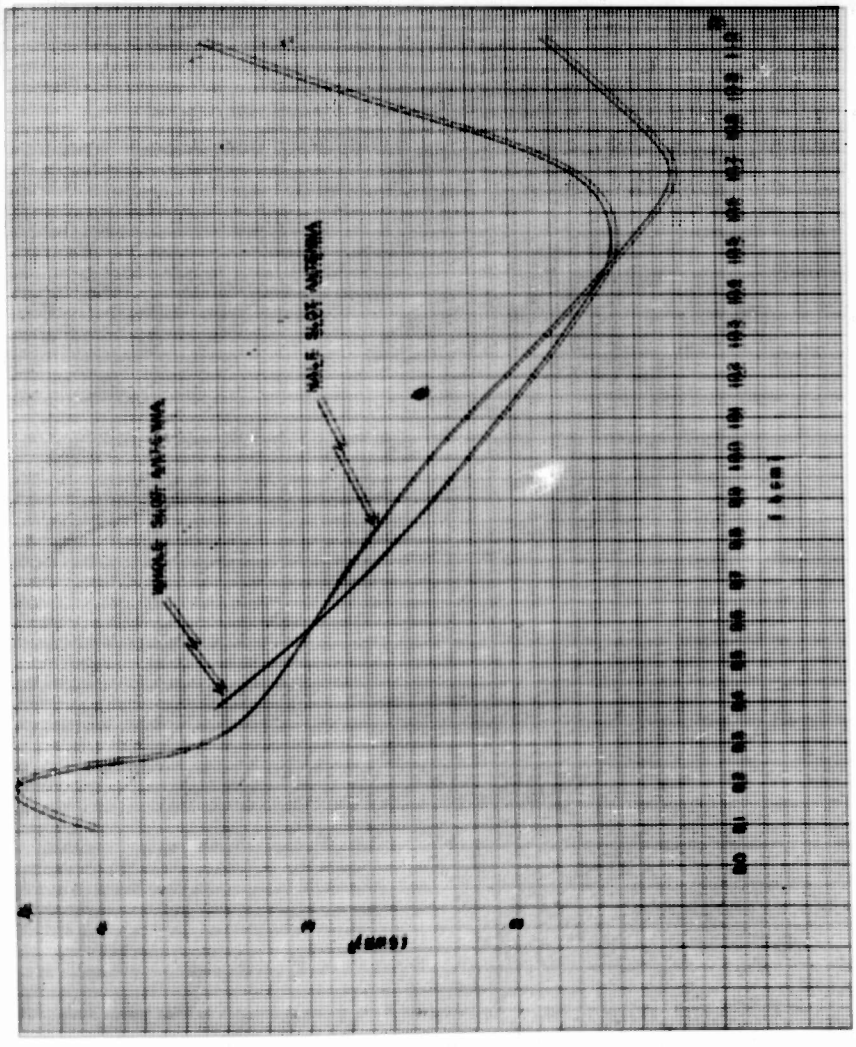

FIG. 5 — $(SWR)^2$ OF SLOTTED BEACON ANTENNAS

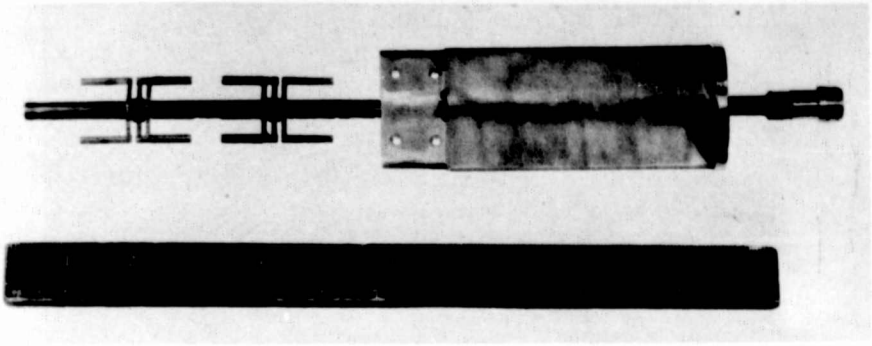

FIG. 6 — SINGLE LINE H-ELEMENT

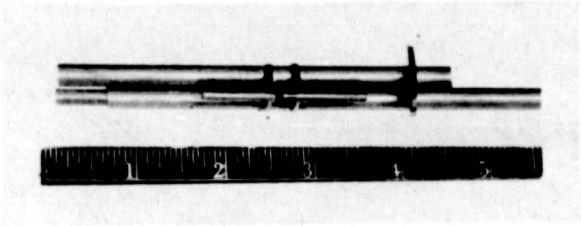

FIG. 7 — DOUBLE LINE H-ELEMENT

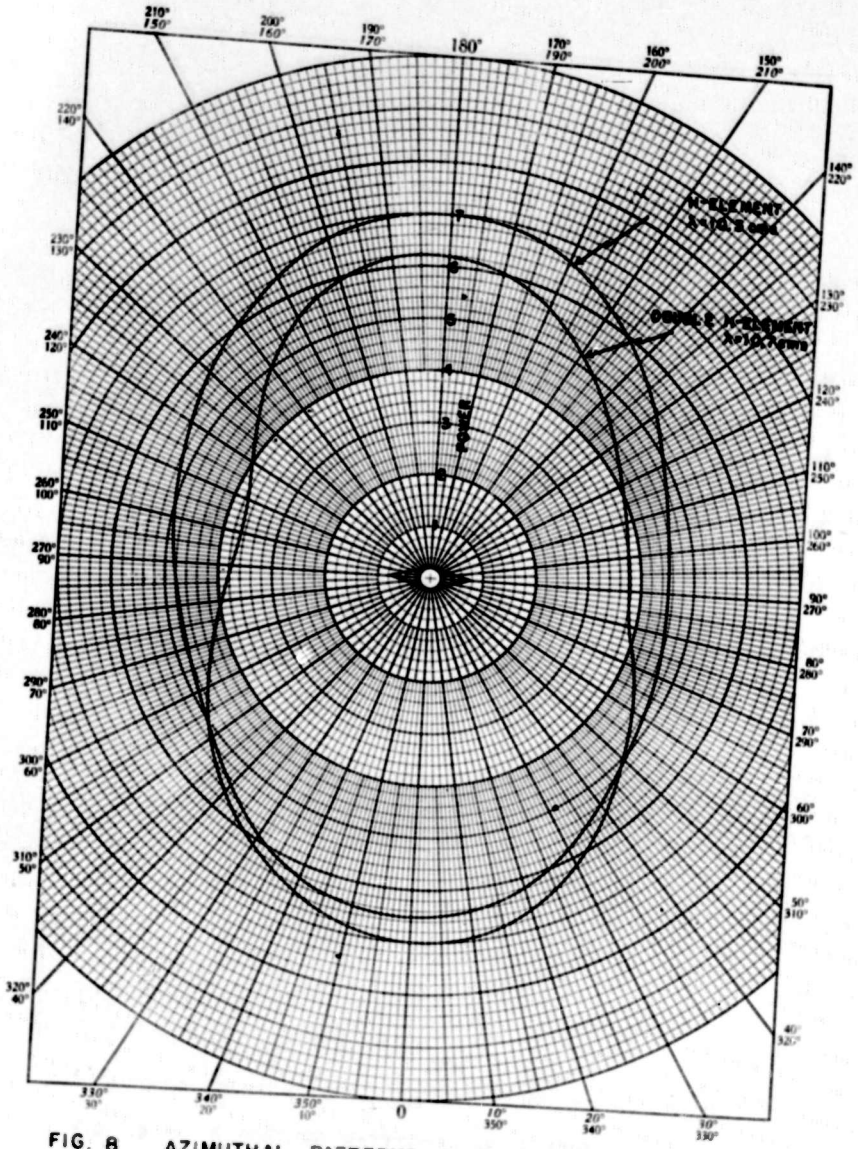

FIG. 8 AZIMUTHAL PATTERNS OF H-ELEMENT ANTENNAS

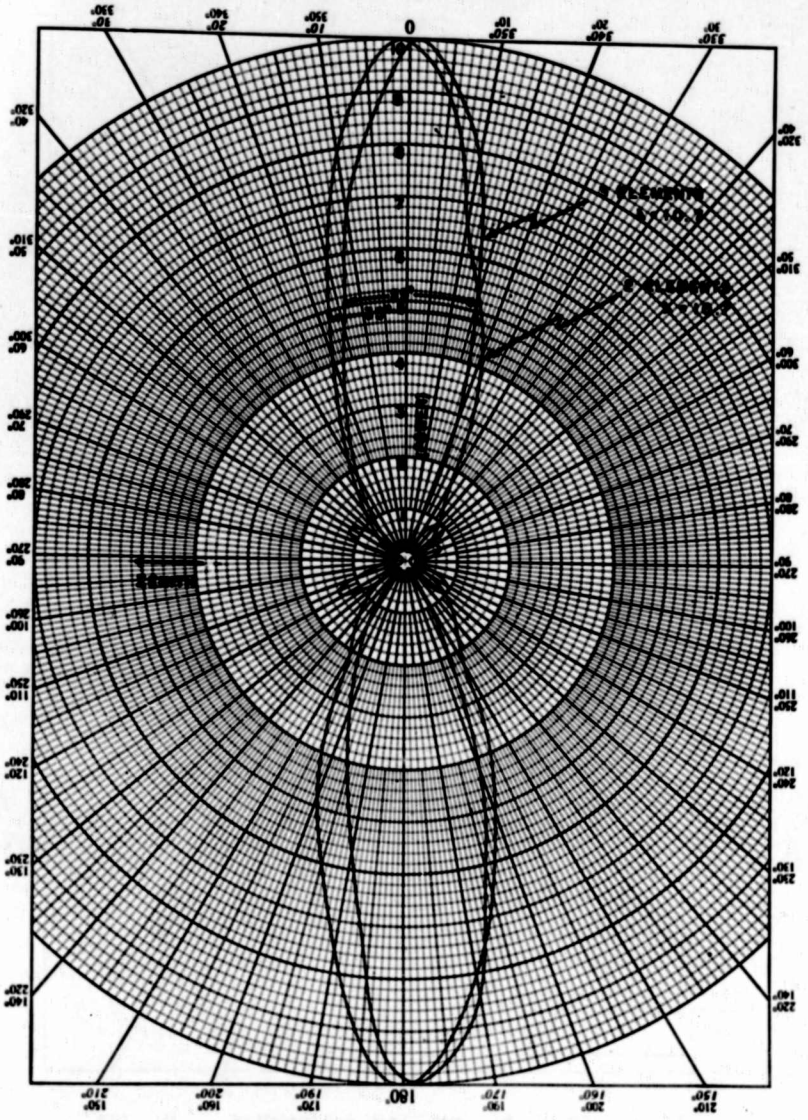

FIG. 9 — ELEVATION PATTERNS OF 2 AND 3 ELEMENT H-ANTENNAS

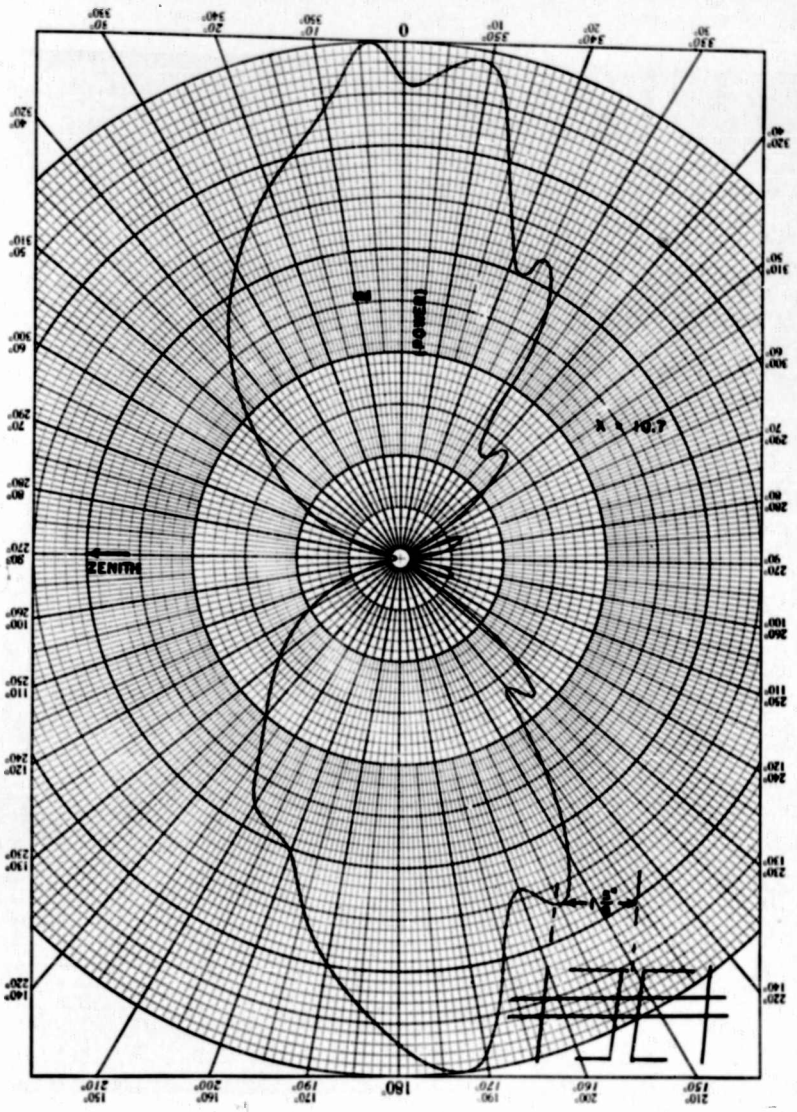

FIG. 10 – ELEVATION PATTERN OF SINGLE DOUBLE H ELEMENT ANTENNA

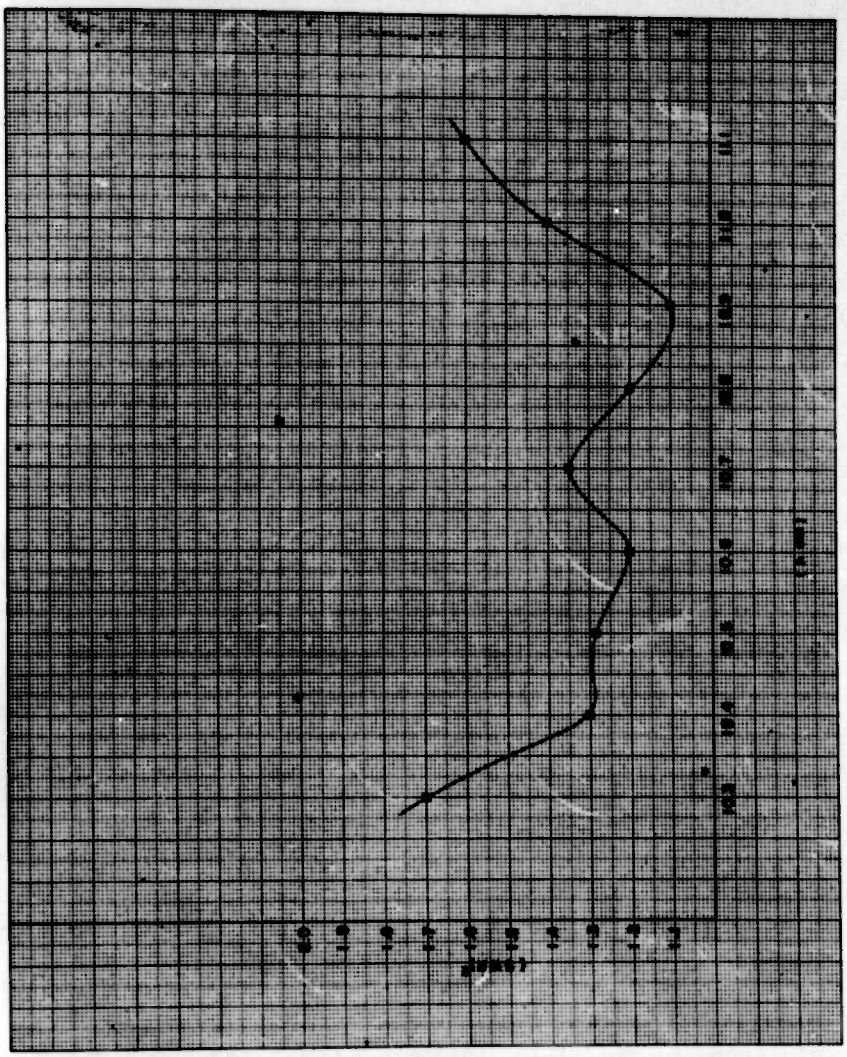

FIG. 11 — $(SWR)^2$ OF 2 ELEMENT H ANNTENNA

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High-speed aircraft require antennas which are streamlined. Details are given of both horizontal and vertical polarization characteristics of S-band antennas. For horizontal polarization a pair of slots on the flat faces of a streamlined section gives excellent results when fed by a slotted dipole. For vertical polarization a pair of vertical dipoles may be used. The designs are such as to provide satisfactory azimuth and elevation with tolerable match.

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A description is given of streamlined microwave omni-directional antennas for use on military aircraft for identification and communication purposes. Details are given of the antennas for both horizontal and vertical polarization at S-band. For horizontal polarization a pair of slots on the flat faces of a streamlined section give excellent results when fed by a slotted dipole. For vertical polarization a pair of vertical dipoles may be used. The designs are such as to provide satisfactory azimuth and elevation patterns with tolerable match.

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