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LABORATORIES

OF

THE NATIONAL RESEARCH COUNCIL OF CANADA

RADIO AND ELECTRICAL ENGINEERING DIVISION

PROGRESS REPORT

ON

CB AND MZPI RADAR EQUIPMENTS

JANUARY - MARCH, 1949

Declassified to: OPEN
Original Signed by I. X. WONG
Authority: [illegible]
Date: JUL 14 1988

OTTAWA

APRIL, 1949

Report ERA-170

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Radio and Electrical Engineering Division

ANALYZED

PROGRESS REPORT

on

CB and MZPI RADAR EQUIPMENTS

January - March, 1949

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COUNTER-BOMBARDMENT RADAR EQUIPMENT

Purpose

The purpose of this equipment is to locate mortars, within any ten-degree sector, out to a range of at least 5,000 yards. For all other purposes for which this radar may be useful, a maximum range of 25,000 yards will be available.

Status at the end of December, 1948

The lens and scanner had been built and tested and provision had been made for mounting these units on the Windsor carrier.

The layout of the r-f head had been completed and the necessary castings received. The i-f amplifier, having a bandwidth of 20 mega-cycles, had been completed, but had not undergone experimental tests, because the design of the input transformer from the crystal mixers was not complete. The construction of the AFC i-f amplifier, discriminator and pulse amplifier had been finished, but these units were not tested.

The ranger had been modified to permit single-modulator operation at 7,000 cycles per second to 10,000 yards, and at 4,500 cycles per second to 25,000 yards. Faster and more precise checks of goniometer accuracy were achieved with redesigned heterodyne-type test instruments, and the error in the goniometers was reduced to a little over one yard.

Greater stability of azimuth sweep amplitude and linearity had been obtained by modifying the oscillator circuit. A circuit, capable of maintaining azimuth calibration with change of azimuth display width, was designed.

The A- and B-scope video amplifiers had been virtually completed, but the extension of the low-frequency range of the latter down to 30 cycles still remained to be done.

Initial tests of the multiplier deck of the computer were encouraging when ball-bearing carriages were employed. Drawings were in progress for other decks of the extrapolation computer.

A simplified two-channel data-transmission servo system had been designed, using a minimum of adjustments and components. The co-ordinate converter had been completed but for gear changes made desirable by a change in Army specifications.

Two r-f test sets, for 60-cycle and 400-cycle operation, respectively, had been started and were ready for the installation of waveguide fittings.

The field trials trailer had been made ready for the tests and a 400-cycle supply reconditioned for field use.

Progress during January - March, 1949

Antenna Gear Boxes

The design changes for the addition of the slow-speed information channel have been completed.

R-F Head

Wiring of the r-f head is almost complete.

A photograph of the mixer and pre-amplifier is shown on the following page. The anti-TR cell may be seen mounted above, and to the left of the TR cell. Due to its broad-band characteristics no tuning adjustment is required on the cell.

Work is being done to reduce the noise figure of the pre-amplifier. A Wallman "cascode" amplifier is used for this purpose. It consists of a triode, running with a grounded cathode. The plate of this triode drives a second triode with a grounded grid.

Azimuth Sweep Generator

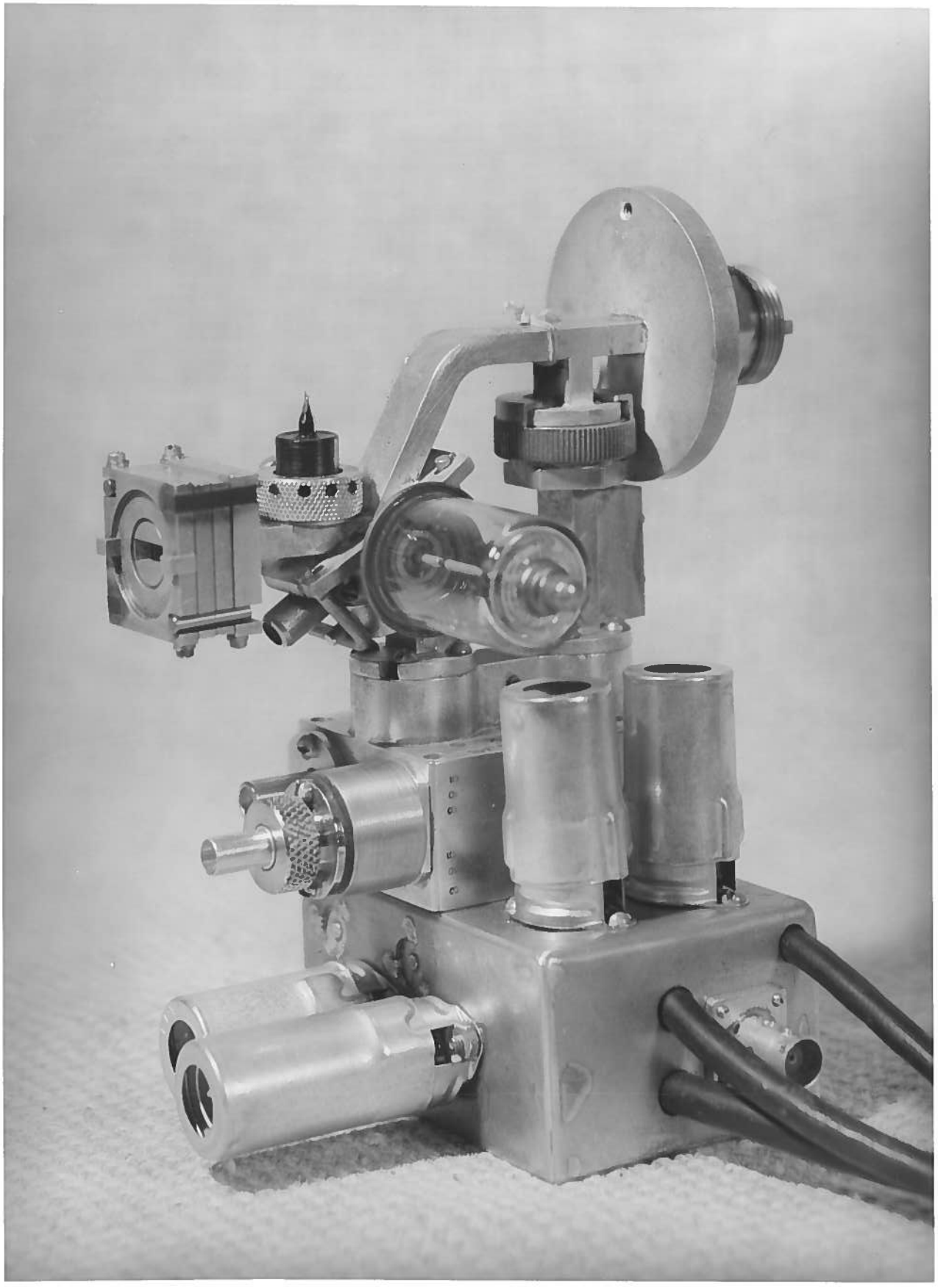
New r-f transformers, having fewer adjustments, were built and installed, with a consequent improvement in sweep linearity. The sweep amplitude control was simplified to permit remote adjustment by the operator.

Azimuth Marker Circuit

This circuit was modified to provide automatic compensation of marker position with change in picture size. The d-c voltage applied to the marker control potentiometer is now derived from the azimuth sweep signal to achieve this. The accuracy of the marker position was improved by using the push-pull sweep output, instead of single-ended operation, as heretofore.

Goniometers

The effect of temperature, source impedance, output impedance, asymmetric shielding and search coil loading on goniometer accuracy has been studied. Tests have now been completed; the final error figures of the goniometer and network, completely shielded are ±0.53 degrees and ±0.42 degrees, corresponding to range errors of ±1.47 yards and ±1.16 yards, respectively.



K-band Mixer
with broad-band, low-noise Pre-amplifier

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Video Amplifier

Tests on the completed B-scope video amplifier indicated that an output circuit of higher impedance is desirable in order to produce sufficient marker amplitude. In order to permit this change, the amplifier will be mounted in the B-scope, thus eliminating the need of a low-impedance cable connection.

Extrapolating Computer

Tests of the ball-bearing-equipped proportional multiplier mechanism were encouraging. Design and drawings of the drive mechanism were completed.

Converter

The mechanical additions to the converter, necessary for the second azimuth servo channel, have been designed and the drawings completed. The range of the converter has been limited to 12,000 yards in order to increase its accuracy.

Data Transmission System

A conventional two-channel servo amplifier was designed, built and tested. However, since there will be several of these units required, it was thought that the number of set-up and operating adjustments should be reduced, if possible. Consequently, a simpler system, using only one tube and transformers, is being tested with encouraging results. An additional circuit may be required to suppress the main channel as the null is approached. This is under consideration.

Test Set

Both the 400-cycle and the 60-cycle units have been completed but for the installation of the wave-guide parts. These parts are being machined.

MICROWAVE ZONE POSITION INDICATOR - MK II (MODIFIED A.A.No.4 MK 6)

Summary

As a part of the program to increase the range of this equipment, an antenna of greater power-handling capacity is required. The prototype antenna will consist of a 2 by 14 foot section of a parabolic cylinder fed from a slotted wave guide. Beam positions will be determined by means of a hydraulic rocking mechanism.

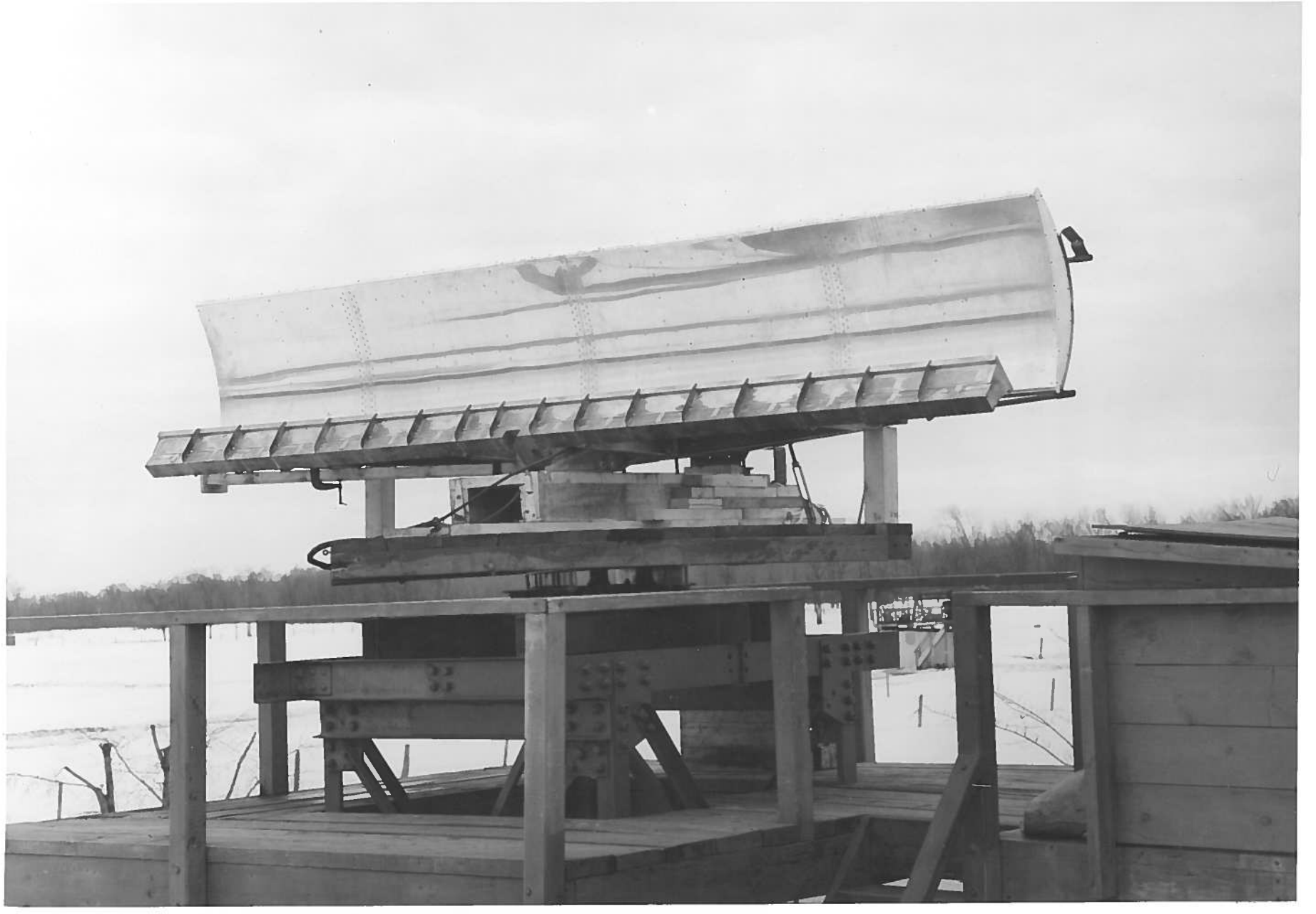
Progress

The initial mechanical assembly of the rotating framework was dismantled early in the period under review and the antenna reflector system was turned over to the Antenna Group for tests (see below). A new set of castings of the hydraulic cylinder and end caps was obtained. These castings were ordered with special attention to their final use under pressure. However, upon pressure-testing the new assembly, one end cap was found to leak. This casting is being replaced by an end cap made from large-diameter Dural bar stock. A hydraulic test bench has been made up, and over-all testing of the new hydraulic mechanism will soon be started.

Drawings have been completed showing revisions to the antenna-reflector wave-guide assembly. These revisions are the result of tests by the Microwave Section on the initial assembly, and mainly involve changes in the position of the wave guide relative to the antenna reflector.

Horizontal radiation patterns were taken for the new antenna, with the beam in each of the three positions -- low, medium and high (see photos and figs. 1, 2, 3). In each case, the patterns were found to have the same beamwidth as for the old antenna, but with appreciably smaller side lobes.

Vertical radiation patterns were then taken for the beam in each of the three positions. The composite coverage was found to be insufficient at very high angles. This fault was corrected by moving the feed array about two inches out of focus, and by spreading out the three vertical beam positions. The resultant vertical coverage diagram is being prepared.



New MZPI Antenna
mounted on turntable for recording of horizontal patterns

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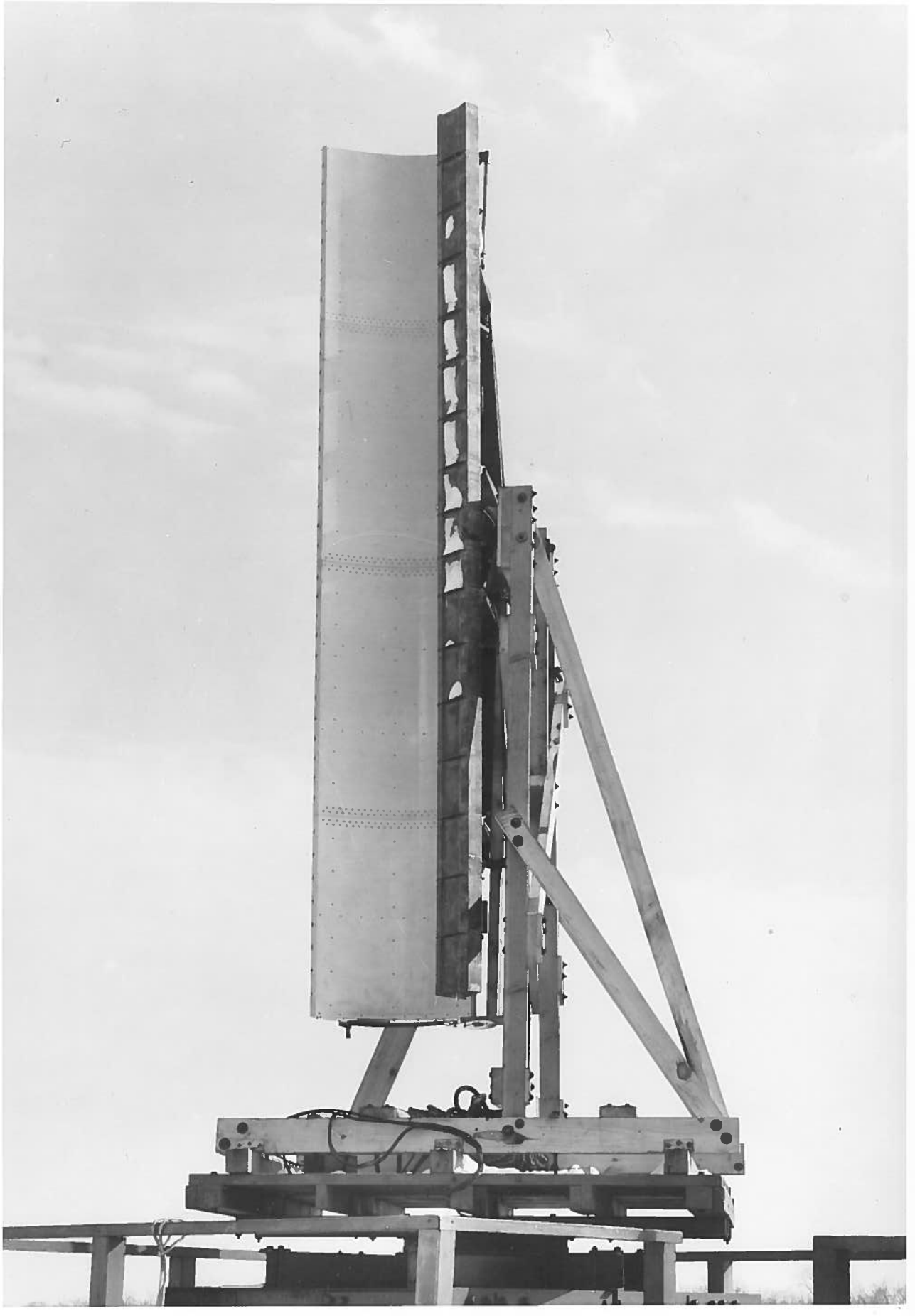

New MZPI Antenna
mounted on turntable for recording of vertical patterns

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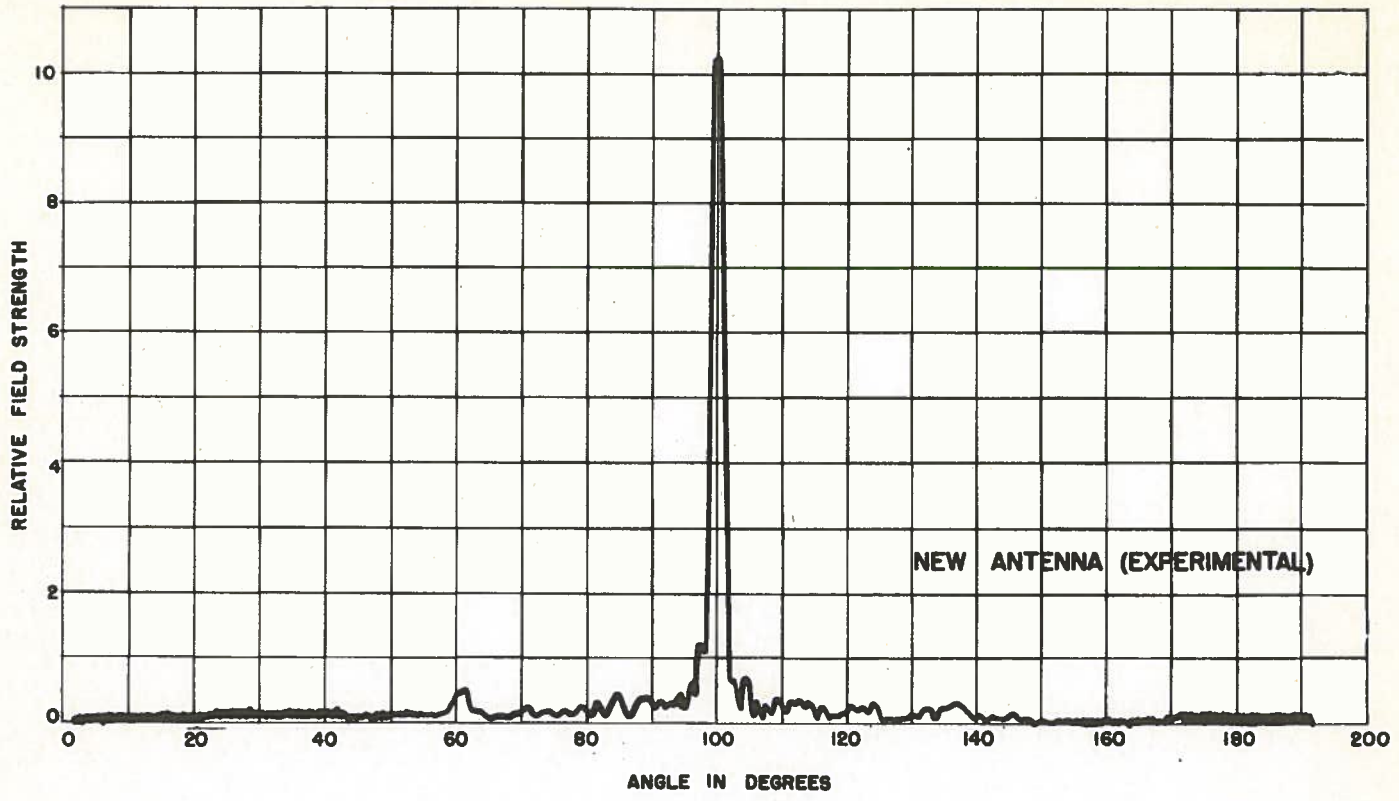


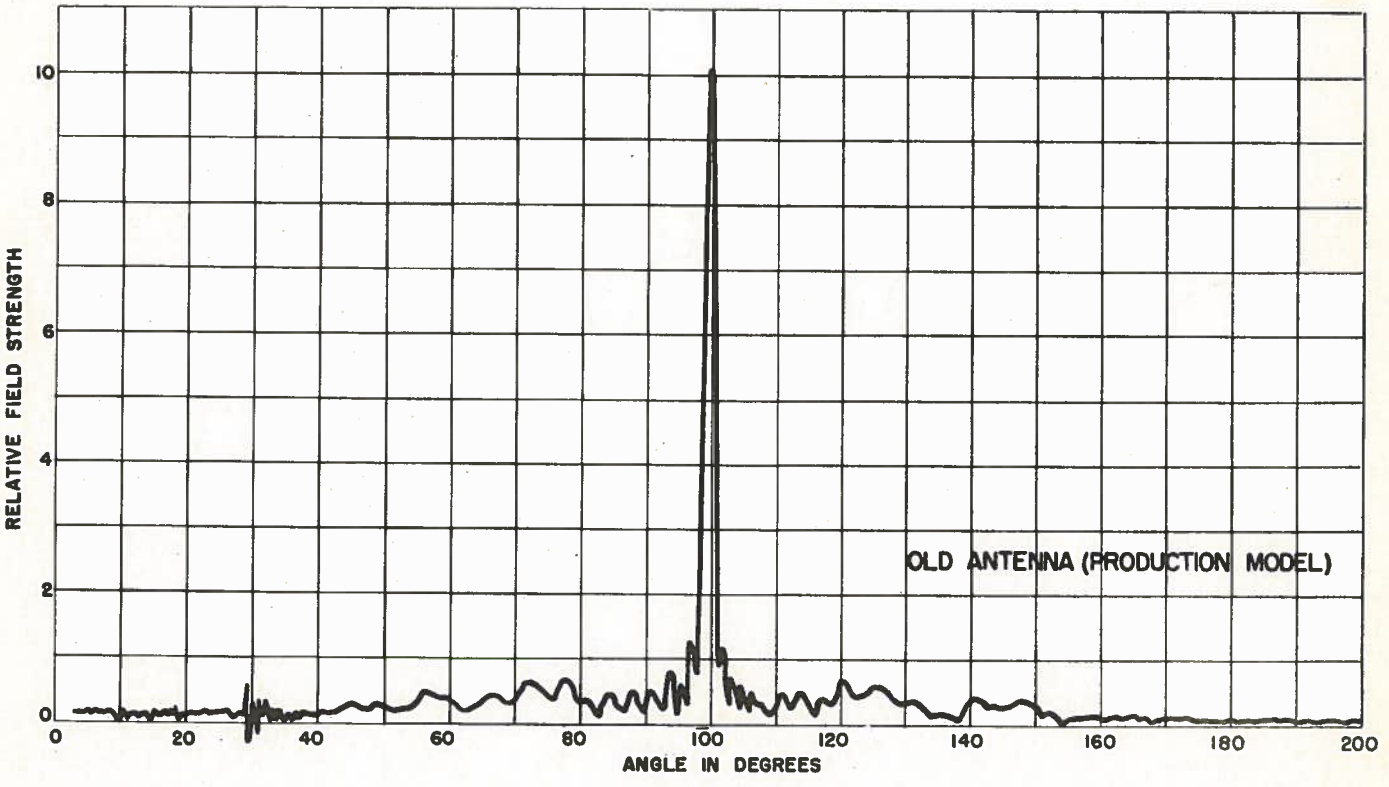
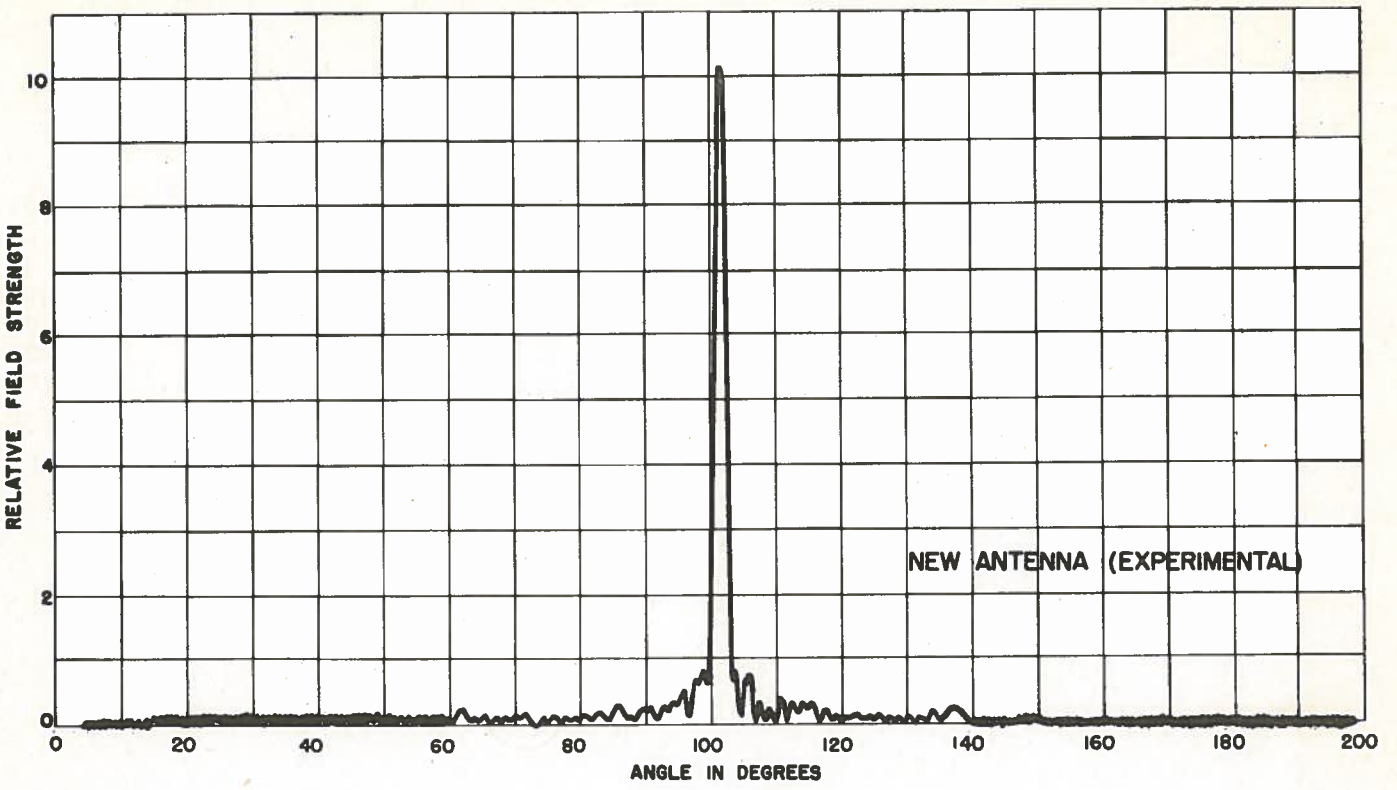


FIG. 1

HORIZONTAL RADIATION PATTERNS FOR MZPI ANTENNAS, BOTH OLD AND NEW

LOW BEAM--(λ = 10·7 cm.)



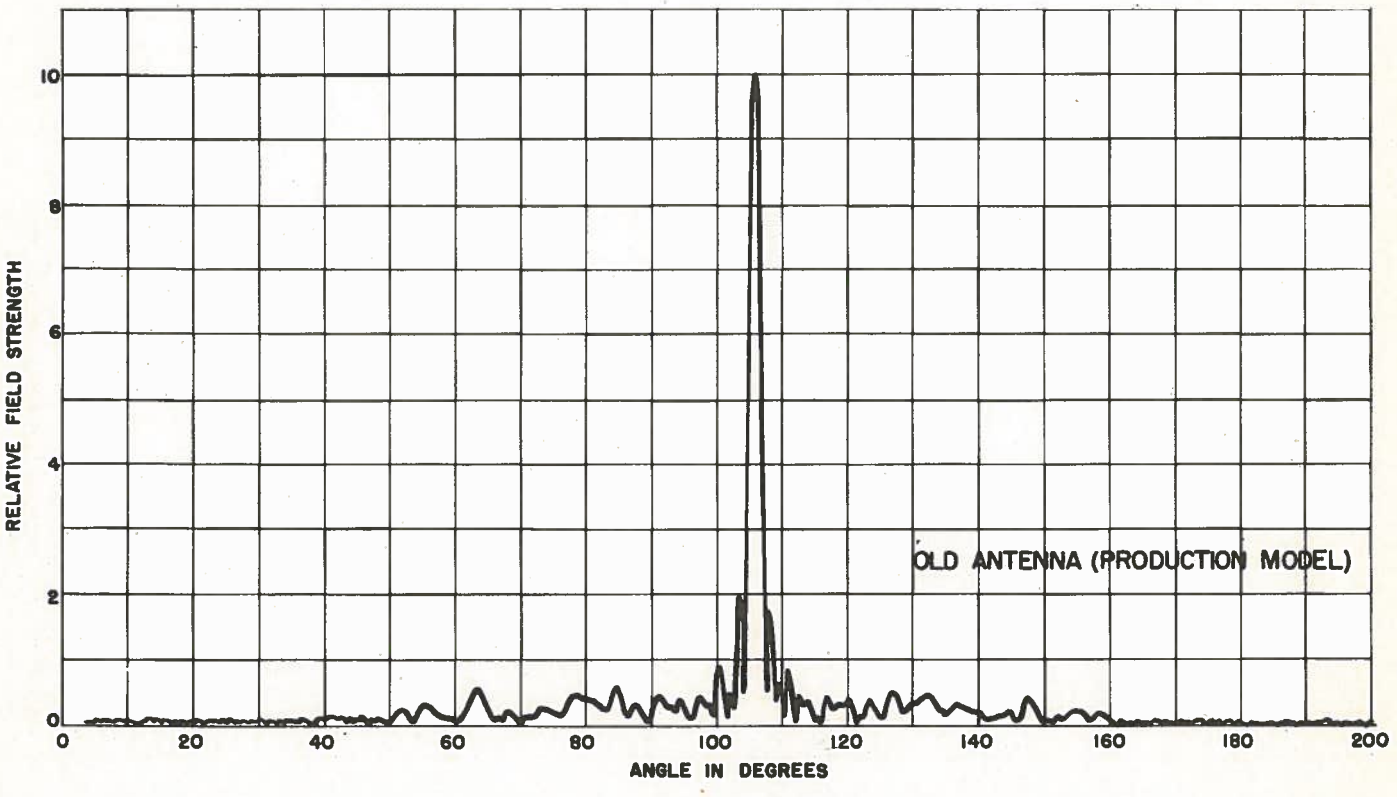
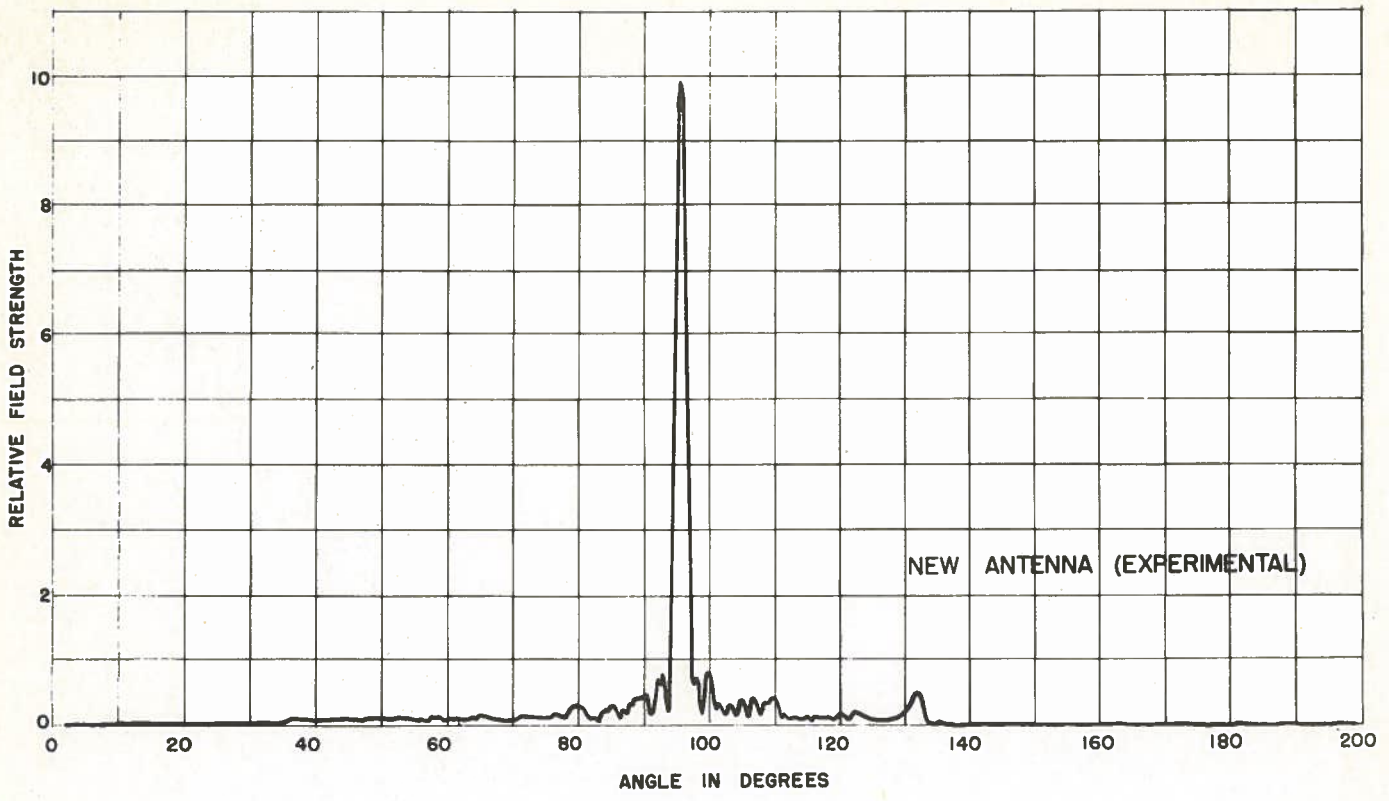


FIG. 2

HORIZONTAL RADIATION PATTERNS FOR MZPI ANTENNAS, BOTH OLD AND NEW
MEDIUM BEAM (λ=10·7cm)



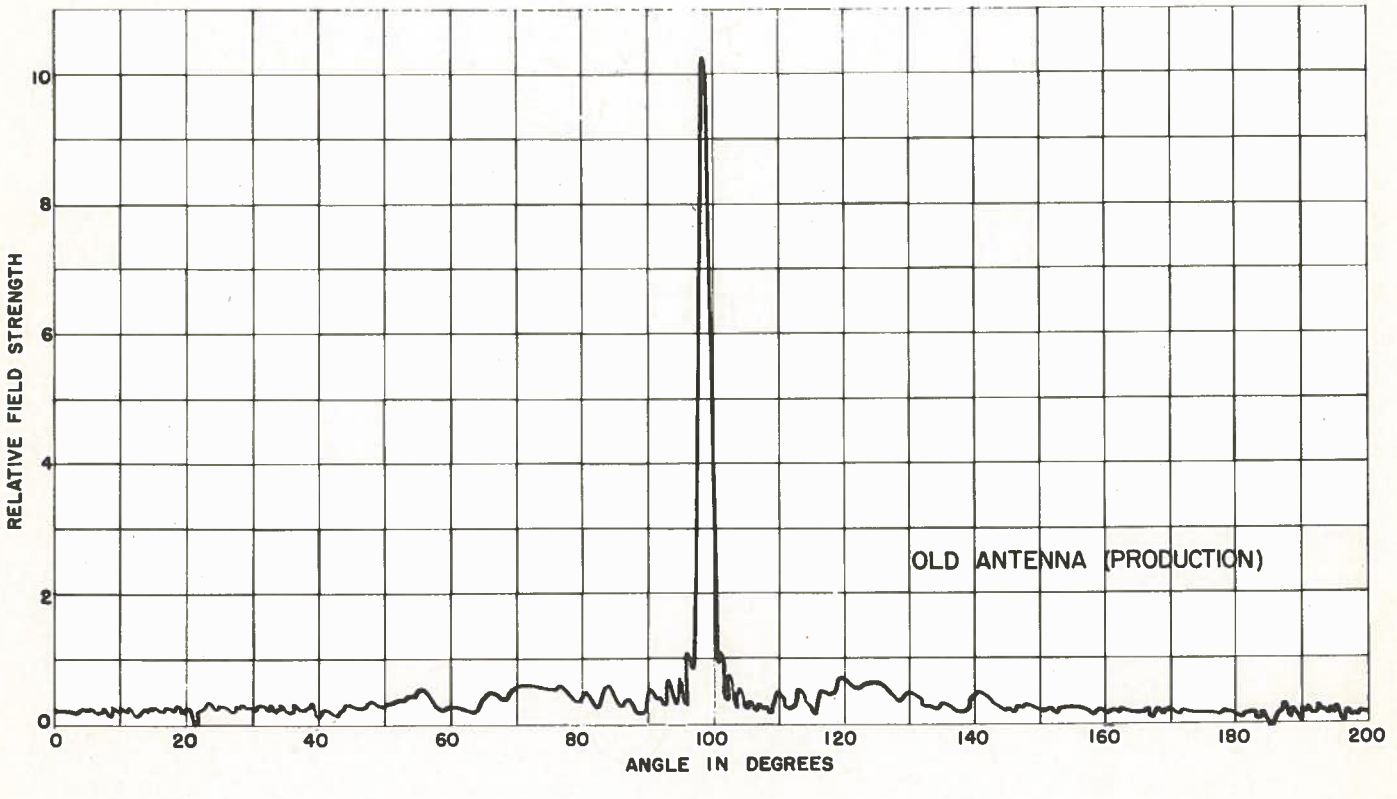


FIG. 3

HORIZONTAL RADIATION PATTERNS FOR MZPI ANTENNAS, BOTH OLD AND NEW

HIGH BEAM--(λ=10·7cm)

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