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STUDY AND INVESTIGATION OF A UHF-VHF ANTENNA

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ABSTRACT

A comparison of theoretical and experimental beam patterns for the equiangular spiral will be available shortly. Preliminary tests of magnetic bias on the ferrite-filled rectangular slot indicate that the resonant frequency of the slot increases with increasing magnetic fields. Further tests of the effects of ferrite loading on VSWR and beam pattern for the log conical and log zig-zag antennas are being conducted. An extension of the frequency range of the antennas is indicated.

1. REPORTS, TRAVEL, AND VISITORS

During this period no reports were issued and no one visited the laboratory on project business. A trip was made to Wright-Patterson Air Force Base on February 11, 1964 for discussions with Mr. E. M. Turner and Mr. O. E. Horton. Dr. T. A. M. Lyon and Mr. R. M. Kalafus represented this project.

2. PERIOD ACTIVITIES

2.1 Equiangular Spiral

Test models of a thin wire equiangular spiral and its complement, the equiangular slot, are being constructed in order to check experimentally the results of the theory developed in the last bimonthly report.

The computer program for solution of the field equations of the spiral has been freed from errors and theoretical beam patterns are being calculated for the above antennas. Weather permitting experimental results should be available soon.

2.2 Ferrite Loaded Rectangular Slot

A model of the solid ferrite-filled rectangular slot antenna delivered to WPAFB has been constructed and preliminary tests of the effect of strong magnetic bias are being conducted. First results indicate that the resonant frequency of the antenna increases with increasing magnetic bias. These results were obtained for a nonuniform

magnetic field aligned with the "E" field and across the aperture of the antenna using a Varian magnet with pole faces 4 inches in diameter.

2.3 Log Spiral Zig-Zag Antenna

Preliminary tests have been made on the log spiral zig-zag antenna both in air and embedded in ferrite powder. The construction data for this antenna were obtained through a reference by Tang and McClelland.[1]

During the same period, an aluminum cavity was constructed to fit the antenna. The purpose of the cavity construction was to investigate the flush-mounted operation of the antenna.

For the preliminary tests the zig-zag antenna was loaded with a thin layer (0.5 inches) of ferrite powder. The voltage standing wave ratio was measured for different frequencies and compared with the same structure without ferrite powder.

The radiation patterns for the zig-zag antenna were also taken at several selected frequencies for the loaded and unloaded cases.

The effect of the cavity was initially tested by comparing values of VSWR for both the loaded and unloaded cavity. For the ferrite loaded cavity, the powder "A" was used for a depth of approximately five inches which covered the bottom two turns only and provided a thickness of approximately 1.5 inches.

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[1] C. H. Tang, O. L. McClelland, "Polygonal Spiral Antennas," Antenna Lab. Tech. Rep. No. 57, Univ. of Illinois, June 1962.

2.4 Log Conical Spiral Antenna

In previous reports several different methods of loading and their effects on radiation patterns as well as the VSWR were reported. As a final test on loading, a conical antenna with hollow center was designed to observe the effect of loading inside the antenna with the ferrite powder. The design data were the same as reported previously for the small log spiral cone. The tests are continuing at the present time.

3. FUTURE RESEARCH EFFORT

3.1 Equiangular Spiral Antenna

Theoretical and experimental patterns will be obtained and compared, including the case of a thin ferrite load.

3.2 Ferrite Loaded Rectangular Slot

Magnetic tuning experiments will continue utilizing both uniform and nonuniform bias in an effort to arrive at the optimum method of tuning the antenna. Various orientations of the magnetic axis will be used.

A test will also be made to determine the effects of removing some of the ferrite material from slot. The effect on VSWR and pattern will be investigated.

3.3 Log Conical Spiral Antenna

As a final experimental study of the antenna, an Amphenol "subminax", 50-ohm cable will be used as a radiating element. Also

the cavity backed antenna with a large ground plane will be used to investigate further the radiation patterns of the antenna with and without ferrite powder loading. It is hoped that a final experimental model of this antenna will be obtained at the end of the period.

3.4 Log Periodic Zig-Zag Antenna

An effort will be made to study radiation patterns of the antenna with and without the ferrite powder. Also, radiation patterns for the cavity-backed antenna with and without the powder will be studied.

3.5 Electric Bias Study

A preliminary study of the possibilities of shifting the operating frequency range through the use of electric bias is being made. If the effects can be made sufficiently pronounced on a practical antenna then the light weight of the electric field source could become influential. No results are now available. Of course sufficient nonlinearity of permittivity must be present.

4. SUMMARY AND CONCLUSIONS

Construction of test antennas and completion of the computer program indicate that a comparison between theoretical and experimental beam patterns will soon be available. It is hoped that the effect of a thin ferrite loading may be theoretically predicted.

A ferrite-filled rectangular slot has been constructed and preliminary tests of the effects of nonuniform magnetic bias completed.

A continual increase of resonant frequency with increasing magnetic bias is indicated. There are no inflections in the resulting graph. Further tests of both uniform and nonuniform bias will be made.

Since, to date, only preliminary tests have been made on the log conical and log zig-zag antennas, no definite conclusions can be made.