ENGINEERING RESEARCH INSTITUTE
THE UNIVERSITY OF MICHIGAN
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UPPER-ATMOSPHERE WIND, TEMPERATURE, AND PRESSURE MEASUREMENT

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This report, not necessarily in final scientific form, is intended for internal management uses of the contractor and Air Force.

Approved by:
N. W. Spencer
Project Supervisor

Project 2096

GEOPHYSICS RESEARCH DIRECTORATE
AIR FORCE CAMBRIDGE RESEARCH CENTER
AIR RESEARCH AND DEVELOPMENT COMMAND
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PERSONNEL EMPLOYED DURING THE PERIOD OF THIS REPORT

R. L. Boggess	Project Engineer	Part Time
L. H. Brace	Technician	Part Time
J. A. Cornell	Technician	Full Time
R. G. DeLosh	Technician	Part Time, Student
W. G. Dow	Consultant	
R. B. Jones	Technician	Part Time
W. G. Kartlick	Technician	Full Time
M. R. Kestenbaum	Engineer	Part Time, Student
A. A. Kirsons	Engineer	Full Time
D. L. McCormick	Machinist	Part Time
G. A. McPhillips	Technician	Part Time, Student
T. A. Muller	Technician	Part Time, Student
J. Pua	Technician	Full Time
D. R. Rush	Technician	Part Time, Student
P. M. Shaler	Technician	Part Time, Student
H. S. Sicinski	Project Physicist	Full Time
D. K. Scharmack	Technician	Part Time, Student
R. E. Schwartz	Technician	Part Time, Student
N. W. Spencer	Supervisor	Part Time

INVESTIGATIONS BEING UNDERTAKEN

The major effort during this period has been the construction of the alphatron measuring system, developed under separate contract. This system consists basically of the following sections; an alphatron gage, a direct coupled amplifier, a servo range-switching section, primary batteries, and a transistor power supply. The actual details of the construction of the system have been worked out, and the procurement of enough components for fifteen units has been effected. Much of the subassembly work has been completed, and a number of complete units are expected to be functioning shortly.

The design of the system had as its main objective the feature of unitized construction. The above listed units can be interchanged in the system in case of a field failure, thus eliminating time-consuming circuit checks within the unit. Another objective was to make the system independent of other missile wiring in order to keep rack wiring minimized. The basic sections of the system will be briefly explained here. It is expected that a Technical Report will be prepared following the firing of the prototype missile, and the design details will be discussed more fully.

The alphatron gage is a well-known device in high-vacuum technology and consists of an ionization chamber and a radium source. The ion current is passed through a high-megohm resistor, across which a measurable voltage is developed.

The amplifier used in measuring this voltage is in actuality an impedance matching device to allow ordinary meters of 1000 ohms per volt to monitor the alphatron gage voltage. Unity feedback is incorported, which makes the output of the amplifier look like a very low impedance source. Subminiature duo-triodes are utilized throughout, and zeroing can be accomplished from the blockhouse.

Insertion of the proper value of high-megohm resistance compatible with existing gage current is accomplished automatically by means of a servo system utilizing subminiature thyratrons to energize Ledex stepping motors. In this amplifier, eight ranges are used, allowing measurement of pressures from approximately atmospheric to 10^{-3} mm of mercury.

System power is developed from a primary source of Yardney Silvercels energizing a transistor power supply. The power-supply output (d-c) is 95,150, and -45 volts. The primary cells are used to supply filament power directly.

The major portion of the desired fifteen units has been completed during this period, this being the number needed for the two Cajun-Nike missiles and the Aerobee scheduled for this year. Three units are to be used in each of the small missiles, and five in the Aerobee.

In addition, work is almost complete on the first Cajun instrumentation and rack. The Aerobee rack design has been completed and work on construction has started.

Work has also proceeded on the Vane-Machmeter experiment for the fall Aerobee missile. It is now anticipated that three vanes will be used with their associated transducer systems. The instrumentation will make use of previously flown techniques with some changes to improve the reliability of the system.

DATA REDUCTION

During this period, results of a rocket sled run of the previous quarter were examined. Indications are that the electrometer tubes and the high-megohm resistors used were not affected by the acceleration and deceleration of the sled. Peak acceleration was found to be 55 G's, more than one will expect to encounter in the Cajun missile.

The above-mentioned instrumentation involved three electrometer tubes oriented on three mutually perpendicular planes. Also included were three high-megohm resistors, positioned such that each would received the acceleration force in a different direction. The electrometer tubes were placed in a simple operational circuit for the duration of the run and no change in the original characteristic curves could be detected following the test. No data were telemetered during the sled run since it is not anticipated that alphatron system operation will take place during the burning period of the small missile.

Also flown during this quarter was a Vane-Machmeter feasibility experiment. This instrumentation was flown on Aerobee-Hi Test Round No. 3 at Holloman Air Force Base. It consisted of two uncovered vanes mounted on the shafts of low-inertia potentiometers. Variation of the output voltage due to resistance changes gave an indication of vane angular position. These vanes, as well as a third covered vane, utilized a slipring mounted on the shaft just below the vane and connected in continuity circuit, which indicated the presence or absence of the vane by means of a discreet voltage change.

The results of this experiment indicate that all vanes survived the flight beyond zenith. Positive results were obtained in the case of the heavier of the

uncovered vanes in that it was recovered still affixed to the shaft at the site of impact. The continuity circuit could not be rechecked since the vane was damaged during recovery operations. No similar results are available in the case of the other uncovered vane due to its orientation at impact. It was beneath the missile and was therefore destroyed.

The cover remained on the third vane during the entire flight and was recovered undamaged. It furnished definite proof that the vane cover does protect the vane. Indications of heating were found on all of the instrumentation.

A complete data report and analysis of this experiment will be incorporated in a Technical Report which is being prepared at this time.

PERSONNEL, FISCAL, AND ADMINISTRATIVE INFORMATION

Mr. R. A. Minzner of AFCRC, Mr. E. C. Hutter of R.C.A., and Mr. R. Decrevel of Bell Aircraft met with Michigan personnel on May 7-8 to discuss future upper-atmosphere research.

Mr. N. W. Spencer attended a SCIGY meeting in Washington in May.

A DAN Subcommittee meeting on June 25 was attended by N. W. Spencer, H. S. Sicinski, and R. L. Boggess. The discussion pertained to the forthcoming firings of the Nike-Cajun missiles.

Mr. L. H. Brace, Mr. R. B. Jones, and Mr. P. M. Shaler joined the project as technicians during this period. They are undergraduates and will work part time while continuing their studies.

Mr. J. Pua, a graduate student, joined the project temporarily to aid in the construction of the alphatron systems for this year.