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CONTROL NO. 114
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$ 201,770
10 mos.

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(b)(1)
(b)(3) 10 USC 130

GROUP - 1
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and Declassification

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(b)(1)
(b)(3) 10 USC 130

[redacted]

Induced Magnetic Moment: It is well known that a body, when placed in an external magnetic field, will have an induced magnetic moment caused by the external field. The technique used in the variable-mu detection system is composed of two parts: 1) the generation of an "artificial" magnetic moment in the target by creating an external field, and 2) the detection of the field produced by this induced moment.

Phase Detection: The heart of the variable-mu system is the active field

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source (coil) which introduces a magnetic dipole field at a discrete frequency, and a high frequency variable-mu magnetometer. With the use of coherent detection techniques, it is apparent that a number of target effects cannot be explained by a change in magnitude of magnetic field. Thus, in some manner, the target appears to the sensor as not only a magnitude change of the induced field, but also as a change in phase of this field as referenced to the coil field. The introduction of phase changes (time delay) by ferromagnetic material is treated by Richard M. Bozorth ("Ferromagnetism," D. Van Nostrand Co., Inc., 1951), but the sum knowledge of this effect is not sufficient to use phase detection as a means of target identification at this time [redacted]

(b)(1)
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Experimental Models:

The extent of the work to date is such that equipment for an experimental model of the detection system can be fabricated and installed in a light plane for basic testing. The tests to be performed with this first flyable system are critical and will dictate the design of a prototype system.

Mechanical Rigidity: The prime objective of the initial tests will be to determine the mechanical rigidity required for successful operation. The basic

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electronics of the system is now capable of eliminating a large portion of the noise problems generated by plane vibration. However, the problems associated with flying such a system will not become apparent until flight tests are made.

Electronic Design: Most of the electronics has been designed for an experimental model. For a flyable system, however, design sophistication will be required in order to improve the operational reliability and to simplify the system operation.

System Geometry: Much of the work which will yield optimum sensitivity patterns will be done in the laboratory. These results must be translated into a design capable of operation in rather limited available space. For the experimental model, provisions will be made for making small geometry changes so that optimum sensitivity patterns can be obtained while in flight.

Prototype Model:

The work done on the prototype model will reflect the results of the laboratory and experimental studies. The initial task will be to study the aircraft to be provided by the customer so that the design of the experimental models will be compatible with the environment with which it will interface and in which it will operate. This will permit the fabrication of a prototype with a minimum of redesign.

The prototype will be installed in the aircraft provided by the customer. Data readout and displays will be designed to meet the customer's requirements and will be provided as a part of the prototype.

Technical Program:

The tasks to be performed will be aimed at the ultimate objective of fabricating a magnetic variable-mu sensor and detection techniques recently developed at The Electro-Mechanics Company.

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Emphasis will be placed on the electronic design and fabrication, the optimization and fabrication of the system geometry, and on field and flight tests for the system evaluation.

The emphasis on electronic design and fabrication will be primarily concerned with upgrading the existing instrumentation, designing the system to operate on aircraft power, and designing data readout and display systems.

The optimization of the system geometry will require a theoretical study of the sensitivity patterns of the coil and sensor. This work will be completed as soon as possible by using computer techniques for the analysis. The results of this study will be examined in field tests.

The field and flight tests will be emphasized throughout the work period. Aside from determining the sensitivity patterns and the optimum geometry of the system, work is required on structural design problems inherent in fabricating an airborne system.

The tasks to be completed include the following:

1. [redacted] (b)(1) (b)(3) 10 USC 130
2. System geometry optimization:
   a. theoretical studies, and
   b. laboratory and field tests,
3. Synchronous detector design and fabrication,
4. Power available and required,
5. Structural design,
6. Flight and field tests,
7. Prototype design and fabrication, and
8. Data readout design.

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