from Robert Kosko

Grumman Project 483

TRACKED AIR CUSHION RESEARCH VEHICLE

FINAL REPORT

VOLUME 1 RESEARCH VEHICLE PRELIMINARY DESIGN

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VOLUME 1 RESEARCH VEHICLE PRELIMINARY DESIGN

Prepared for
DEPARTMENT OF TRANSPORTATION
Office of High Speed Ground Transportation
Washington, D. C. 20591

Contract DOT-FR-9-0003

Prepared by
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Report FSR-ST- 4
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FOREWORD

This final report on the Tracked Air Cushion Research Vehicle (TACRV) has been prepared under Department of Transportation, Office of High Speed Ground Transportation (DOT/OHSGT) Contract DOT-FR-9-0003 in compliance with the requirements of paragraph 5.2.2 of the Contract Statement of Work issued by OHSGT on 14 March 1968.

The report covers Phase II work performed during the period November 1968 to February 1969. It contains the preliminary design and development plan for the research vehicle and a one-year research test program.

The report is submitted as four separately bound documents, identified as follows:

- Volume I - Preliminary Design, Report No. FSR-ST-4
- Volume II - Development Plan, Report No. FSR-ST-5A
  Part 1 - Technical Plans. (Technical plans included in this volume are:
  - Subsystem Development and Vehicle Design Plan
  - Manufacturing Plan
  - Qualification Plan.)
- Volume II - Development Plan, Report No. FSR-ST-5B
  Part 2 - Scheduling and Resources Plan
- Volume III - Research Plan, Report No. FSR-ST-6

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and control law. The basic design has been made versatile by the provision of space for changes in both location and size of suspension elements and use of adaptive type control laws for active system elements.

While the vehicle can be operated by one person, an additional test observer/operator plus two additional observers are accommodated in an air conditioned cabin, acoustically treated to bring the speech interference noise level down to 69 decibels.

Section 1

SUMMARY

Phase I conceptual and parametric tradeoff studies for an effective research tool for development and proof of tracked air cushion vehicle technology culminated in this Phase II preliminary design of the TACRV. Thrust for the vehicle is initially supplied by the Pratt & Whitney JT8D-9 Turbofan Engine. At the 29,060 lb (13,182 kg) design weight, the design speed of 300 mph (483 km/hr) is reached in 2.16 mi (3.5 km) in less than 50 seconds. Air drag and the normal braking system (air brakes, reverse thrust and friction brakes) bring the vehicle to rest in 1.86 mi (3 km). An independently actuated emergency braking system utilizes parachutes in place of air brakes and reverse thrust to provide equal deceleration performance.

Provision is made for installing linear induction motor (LIM) systems of increasing power with on-board and wayside energy sources. In the final configurations, the aero propulsion may be removed, and the required performance attained with LIM alone.

The vehicle is designed to operate in a double box guideway protected from side winds. Its main body contains the cabin, all propulsion and service power systems and the guidance cushions. The chassis provides the support frame, and air duct system for four levitation cushions and contains the Lycoming PLF1A-2 Turbofan Engine. Body/chassis mass ratios > 4 (without ballast) provide an excellent base for a wide dynamic test range.

Eight peripheral jet-type air cushions guide and support the vehicle in the guideway. The 140 lb/sec (59 kg/sec) air supply at a pressure ratio of 1.28 from the PLF1A-2 turbofan is ample to maintain a 0.75 in. (19 mm) clearance at maximum vehicle weight, 44,820 lb (20,330 kg).

Body and chassis are joined through a secondary suspension system at each end of the body. Passive characteristics in heave, pitch and roll are initially set for 1 cps. Active control components provide the required force outputs to achieve smooth cabin ride with particular system disturbances and ± 5 degrees roll bias. Dynamic analyses have indicated that the ride goals cannot be collectively satisfied with a single configuration of suspension