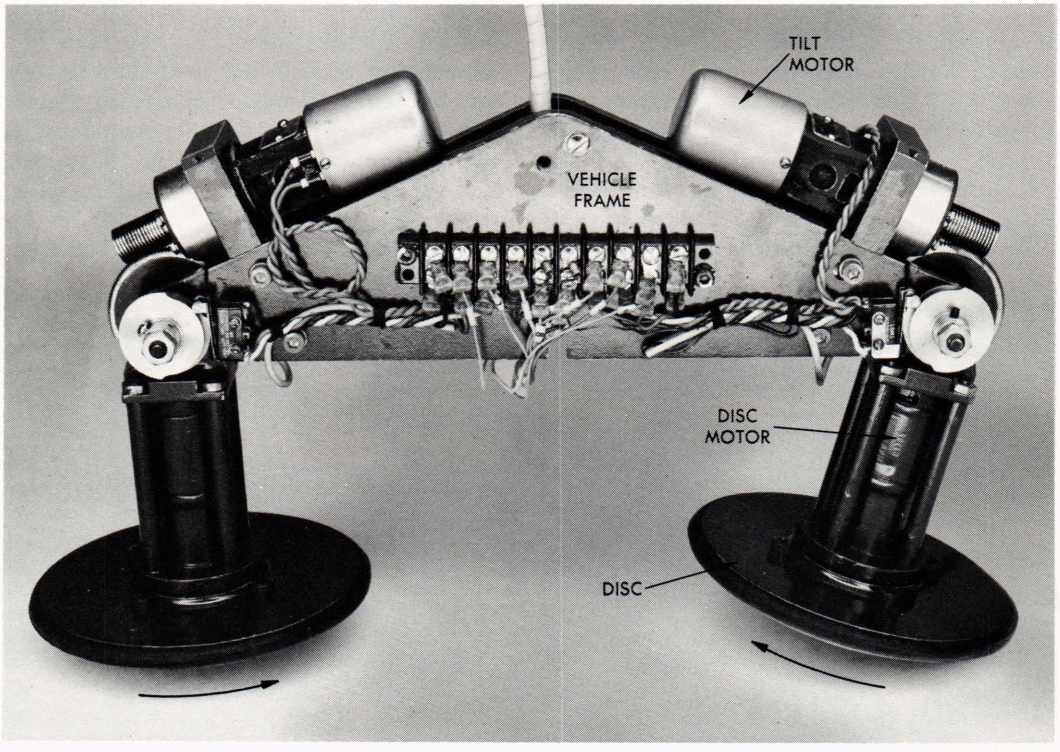
TILTED-DISC DEVICE

Rapid advances in space exploration have given urgency to the need for new types of vehicles for use in lunar as well as earth environments. While most of the larger aerospace companies now have research programs in this field, most are studying some variation of either the track-tread traction system, the wheel, or a leg system for travel in one particular environment. At APL, however, D. D. Scott of the Space Development Division has departed from convention and devised a method of locomotion that provides a hitherto missing factor—adaptability in one vehicle to many surfaces and environments: unknown lunar conditions, hard and soft land, and water. It is termed the "tilted-disc device."

As envisioned in actual use, a tilted-disc vehicle is equipped with several rotating, spherical discs, or caps, independently controlled, which can drive and support a wide variety of vehicle configurations. The curved traction surfaces of the caps may be of several different materials, depending on the terrain and/or environment expected to be encountered. Present possibilities include heavily treaded low-pressure pneumatic tires, wire mesh, flexible metal sections, and treaded metal shells.

Each cap is mounted on the base of a support extending from the frame of the vehicle in such a manner that the axis of rotation of the cap is along the support. In addition, the pivot of the support is arranged to be at the center of

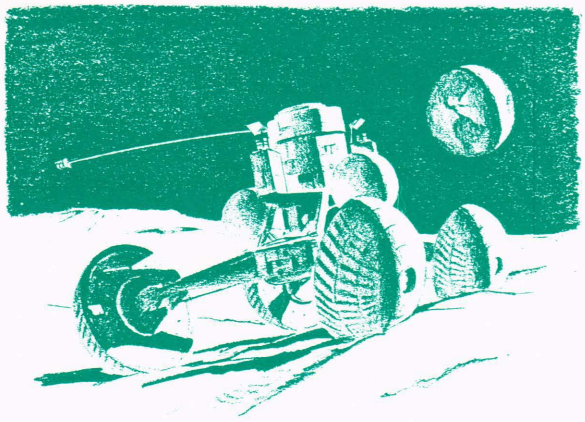


Prototype of the tilted disc device showing the rotating caps, supports housing DC motors, and worm gear linkage between the vehicle and supports.

the spherical surface of the cap so that adjustment of support angle does not tilt the vehicle platform. Supports in the prototype are pivotally connected to the vehicle frame in a way that permits tilting them in one or more planes of motion by means of properly protected reversible DC motors and a worm gear drive. Other methods of tilting may be required for different vehicle configurations or for peculiar terrain conditions; these include hydraulic motors, hydraulic actuators, and mechanical linkages.

Direction and speed of travel are controlled by varying the tilt angles of all supports simultaneously while the caps are engaged to rotate. Independent cap control can also be provided but is not required for obtaining a maximum range of speeds in one direction or for altering direction or vehicle attitude. Total control is afforded when the vehicle utilizes pairs of caps or groups of pairs. If only one pair is employed, however, outrigger supports are essential for vehicle stability.

Maneuverability of a tilted-disc vehicle is far greater than that of one equipped conventionally with wheels or tracks. With caps rotating, movement of the vehicle in any direction from a starting position is simply a result of tilting the supports properly. Reversal of direction of motion without rotation of the vehicle can be readily achieved by simultaneously changing the tilt angle of the supports to the opposite side of the vertical. Turns of any desired degree can be made, from spinning on the vehicle's axis to an infinite-radius turn, by changing tilt angles in the appropriate supports.



Artist's concept of a lunar-terrain vehicle showing an application of the tilted-disc device with hemispherical caps in maximum speed attitude (nearly perpendicular to the vehicle axis).

Operation of the vehicle may, therefore, be controlled by a single control mechanism rather than a maze of levers and pedals. Similar to the cyclic control stick used on some remote-controlled, experimental helicopters, displacement and rotation of a single control stick determines both speed and direction of a tilted-disc vehicle. This simplified control assures smooth operation and maximum maneuverability.

JOURNAL PUBLICATIONS

The following list is a compilation of recently published books and technical articles written by APL staff members.

F. F. Hiltz, "Analog Computer Simulation of a Neural Element," *IRE Trans. on Bio-Med. Electronics,* **BME-9**, 1, Jan. 1962, 12-20.

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A. A. Westenberg and N. de Haas, "Gas Thermal-Conductivity Studies at High Temperature. Line-Source Technique and Results in N_2, CO_2, and N_2-CO_2 Mixtures," *The Phys. of Fluids,* **5**, 3, Mar. 1962-, 266-273.

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