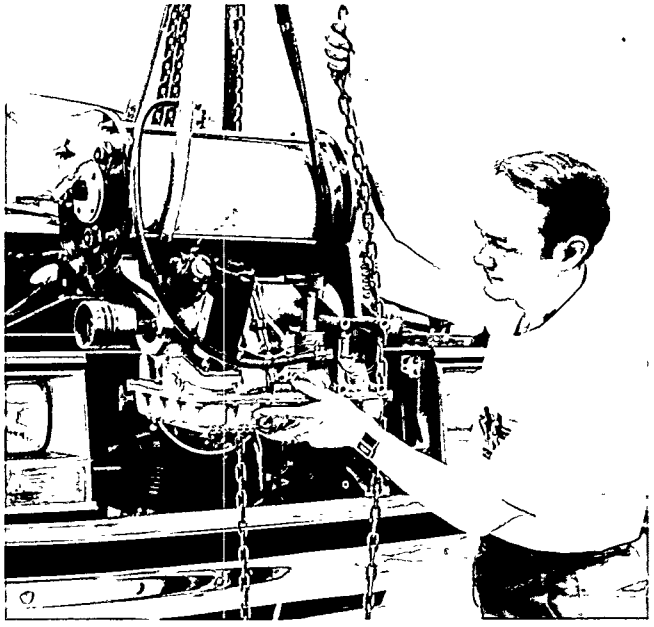

A researcher is installing a power train in a dual-shaft electric-propulsion system.

vehicles that is not only practical for lightweight van applications in the near term but quite sensible from the standpoint of the overall system technology.

Gel-Cell, Lead-Acid Battery-powered Electric Vehicles

DOE has sponsored numerous research activities with the goal of achieving viable, cost-effective electric vehicle technology. Yet maintenance costs have remained a major barrier to the marketability of these vehicles.

Beginning in 1982, DOE initiated an aggressive research effort with universities, the private sector, and Federal agencies to develop technology to reduce vehicle maintenance costs. In particular, gel-cell lead-acid batteries were identified as a technology that could reduce maintenance requirements and improve safety conditions and efficiency levels. Specific results of the gel-cell battery research program include a 50% reduction in vehicle maintenance costs, a greater than 50% increase in energy efficiency, and increased levels of operating safety owing to the sealed design of the batteries.

Gel-cell battery technology developed in this program can also be used in mobile communications systems, mining, computer power supplies, and other applications requiring low-maintenance, long-life, and high-efficiency batteries.

Single-Shaft Electric Propulsion Vehicle

One of the most successful of DOE's electric vehicle research programs was the ETX project (ETX-I and ETX-II) conducted by the Ford Motor Company and General Electric Company. By applying an integrated systems approach, this project advanced electric vehicle technology through the use of alternating current (instead of direct current) and zinc-bromine, sodium-sulfur, and tubular plate batteries.

The ETX-I vehicle was the first electric vehicle to demonstrate a useful range in excess of 100 miles. The ETX-I power train met or exceeded its design objectives for energy efficiency, acceleration, gradability, and drivability. For example, the ETX-I demonstrated a 50% reduction in weight, a 40% reduction in size, and a 25% improvement in acceleration compared with the ETV-1 and other earlier electric vehicles. The project validated the use of the integrated system design for effective use of resources in electric vehicle R&D.

The ETX-I Program was considered an unqualified success. It demonstrated that electric vehicles can effectively compete with conventional vehicles in certain market segments, such as light-duty vans. Small commercial vans were established as the form of electric vehicle most likely to gain acceptance in the marketplace. Accordingly, DOE awarded a new contract to the Ford Motor Company with a subcontract to the General Electric Company to adapt the ETX concept to a small commercial van and take the major subsystems a step closer to production. This second phase, the ETX-II Program, is furthering the propulsion system technology by developing a sodium-sulfur battery subsystem and an advanced, single-shaft, alternating-current power train. The ETX-II is the first of its kind in this country.

The ETX-II Program has resulted in several major technological advances including a new, interior, permanent magnet motor that is much smaller and lighter than a conventional induction motor; an integrated motor and transaxle on one common shaft; high-power transistors capable of handling more than 400 amperes of current; an advanced alternating-current inverter; and integrated-vehicle and electric-subsystem controllers. In addition, a test-bed vehicle