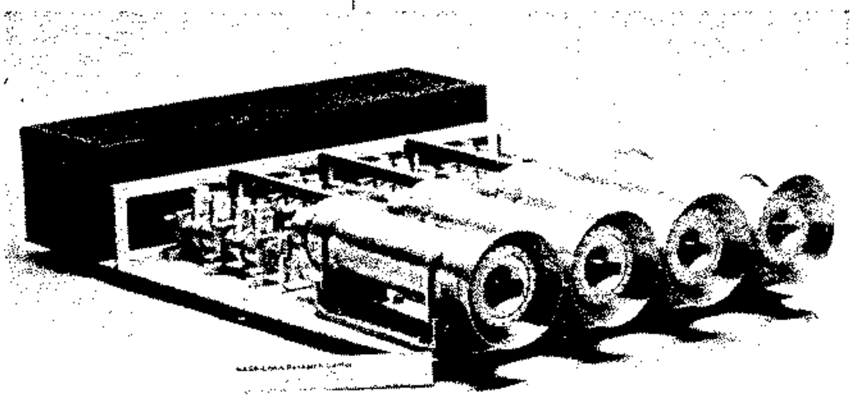
Aerospace Highlights 1987

# Electric propulsion

Millions of dollars have been spent on electric propulsion over the last 30 years. Result: hundreds of studies, substantial hardware of all types, 23 years of flight experiments, but very few operational and only one commercial application. Interest and support rises and falls and missions come and go, with management remaining rock steady in its myopia.

Thus it is with some trepidation that 1987 is suggested as a year with significant indications of an upturn. Apparent commitments to electric propulsion still face many hurdles and first full-blown applications are years down the road. Nonetheless, a number of decisions on electric propulsion do augur well for the technology.



NASA-Lewis and its contractors are working on a bank of resistojet thrusters for the space station that will have a life goal of 10,000 hr while delivering 0.1-0.4 N of thrust.

NASA has approved substantial funding for Pathfinder in its 1989 budget submission. This program will explore the technologies necessary for lunar and planetary exploration, including megawatt nuclear electric propulsion of cargo vehicles. Though magnetoplasmadynamics is being emphasized in early planning, other technologies will be considered before final selection. The Lunar and Planetary Mission Propulsion Working Group is expected to have significant input.

The multipropellant resistojet has been baselined for the space station, complementing the higher thrust electrolytic $H_2/O_2$ steam system. Both use surplus station water. A bank of resistojet thrusters under development by NASA-Lewis and its contractors will have a life goal of 10,000 hr while delivering a thrust of 0.1-0.4 N at a specific impulse of 100-500 sec.

In the request for proposals for the Intelsat-VII spacecraft, xenon ion propulsion has been included as an optional way of extending orbital maneuver life to 15-20 years. Considering the advanced state of xenon electrostatic ion subsystems in Germany, Japan, and the U.S., chances of the option being proposed look good. A single thruster could deliver 25 mN.

A low-power, 1.5-kW arcjet subsystem being developed by Rocket Research for RCA could be the next step in improved north-south stationkeeping performance for commercial communication satellites by attaining a specific impulse of 450-500 sec. NASA-Lewis initiated flight hardware development and RCA is considering using it on a specific spacecraft in the early '90s. Tradeoff studies indicated something of a wash when comparing arcjet and ion propulsion for the application.

A steam resistojet has been selected by Space Industries for reboosting its Shuttle-launched Industrial Space Facility for low-g manufacturing. Lab model vaporizer and resistojet tests will begin before year end. On orbit, four thrusters will operate for 6-7 days about every four months to reboost the 14,500-kg facility from 160 to 200 n.mi. using power from a pair of 14-kW solar panels. At 160-sec specific impulse, materials will have to survive operating in steam at 1,000 C.

Which kind of thruster will use the output of the SP-100 nuclear electric space power plant for primary propulsion has not yet been decided. Studies of the orbit-raising reference mission and early development work on the propulsive payload favor arcjets. But arguments have been made for parallel development of established ion thrusters at higher power. An example of the latter would be the JPL dual 5-kW thrusters. New NASA technical support for the project will come from the first phase of Pathfinder.

Also, the essential element for electric propulsion—power—is becoming more abundant. Solar power capacity on communications satellites is increasing. For example, the power to spacecraft mass ratio of Intelsat-VII will be higher than for either -V or -VI. The SP-100 and Pathfinder nuclear sources will provide power for primary electric missions.

While this eclectic mix of omens does not contain any new announcement of the arrival of electric propulsion on orbit, it does suggest optimism for the field.