aerospace

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TOOLS

For astronauts gone walkabout

Although the Air Force's Manned Orbiting Laboratory is at least three years away, engineers at the Aero Propulsion Laboratory at Wright-Patterson Air Force Base in Ohio are developing a wide variety of devices to aid astronauts in working outside their craft.

Judging by difficulties encountered during Gemini spacewalks, one of the most useful may be a variable-stiffness tether line which can be made rigid in any position to hold the astronaut in the desired relation to his work, says the laboratory's Peter N. Van Schaik.

The tether consists of a series of ball-and-socket joints. Tension applied to a cable threaded through the links increases the friction between them until they lock. The tether can be made limp or stiff simply by pulling or pushing a handle.

Another work aid is an "electro-adhesive pad," which grips any electrically conductive surface when a current is passed through it from a power source which can be smaller than a cigarette pack. Shoe soles, hand holds, safety belt anchors and other objects can be equipped with them. The pads have been made with adhesive forces as strong as 40 pounds per square inch.

ROCKETRY

Medium-sized monster

A possible intermediate booster for earth-orbital work in the 1970's has been proposed by J. F. Meyer and R. P. Dawson of McDonnell Douglas Corp., Santa Monica, Calif., to offer greater payload than the Saturn 1B at less cost than the Saturn 5.

First stage of the booster would be a cluster of four 156-inch-diameter solid rockets, producing a total liftoff thrust of 7.28 million pounds, compared to 7.5 million for the Saturn 5 and 1.6 million for the Saturn 1B. The second stage would be the same S-4B booster now used as the upper stage with Apollo. For lunar flights, Mars flybys and other high-energy missions, a Centaur third stage could be added.

After the Apollo lunar landing there could be as many as nine S-1's and nine Saturn 5's left over to work with (SN: 10/19, p. 387).

MEDICINE

Rabbit power for transmitter

For the past five months, an implanted transmitter has been broadcasting a rabbit's heartbeat to researchers at General Electric's laboratories in King of Prussia, Pa., with the rabbit's body providing the power.

Two electrodes—a round platinum screen three centimeters in diameter and a two-square-centimeter piece of zinc—were surgically implanted in the rabbit's abdomen. Galvanic action between the dissimilar metals produces electricity just as it does in a battery. The system provides 50 microamps of current at 0.8 volts.

The technique could be applied to any implantable device using less than one milliwatt of power, says J. J. Konikoff, notably including heart pacemakers. Though galvanic action does cause slow loss of the electrode material, Konikoff estimates that electrodes measuring only two by two centimeters could provide energy for five years or more.

SAFETY

Rescue hardware suggested

Harpoon guns, telescoping claws and giant nets are among the devices that might be needed to rescue an astronaut from an Apollo-type spacecraft tumbling out of control according to John G. Barmby of the IIT Research Institute.

For a capsule tumbling at less than about five revolutions per minute, a rescuing astronaut might maneuver to within 5 or 10 feet, then literally lasso an antenna or other protuberance and pull himself close enough to extricate the victim from the tumbling craft.

Faster tumbling would require more caution and more equipment. A powered harpoon with attached line might be needed to snag the disabled craft, since rendezvous would have to be made from a safer distance, perhaps as much as 80 feet for a 30-rpm tumble. Over such a distance, a powered maneuvering unit might be required, first to bring the rescuer near quickly, and then to act as auxiliary control to slow the tumbling spacecraft.

At still faster speeds, says Barmby, "the slowing of the disabled craft might be considered analogous to catching a big fish from a small boat."

PROPULSION

Electric upper stage

Despite many active research programs, electric propulsion for spacecraft is still in its infancy. Only one U.S. satellite, ATS-4, has ever used electric propulsion as a primary system (in ATS's case, resistojets for attitude control). But the European Launcher Development Organization (ELDO) is already investigating the possibility of such engines for changing orbits.

In a study for ELDO by England's Royal Aircraft Establishment and Hawker Siddeley Dynamics Ltd., engineers have found electric propulsion potentially suitable for lifting a 1,000-kilogram payload from a 350-kilometer-high circular orbit—about the capability of ELDO's Europa I Booster—up to a synchronous orbit some 37,000 kilometers above the earth. Without some such kind of upper stage addition, the unaided Europa I could put only about 170 kilograms into synchronous orbit.

Such maneuvers with electric propulsion pose some unusual problems, however, largely because most types of electric rocket engine produce little thrust, but operate over a long period of time. Where the transfer might take a few hours with a chemical upper stage, says R. C. Godwin of Hawker Siddeley, the electric version could require 10 months.

Despite its drawbacks, such a relatively low-powered upper stage could be useful, Godwin observes, to countries with only limited launcher development potential.