SPACE

Space Movement Studied

➤ THE NATIONAL Aeronautics and Space Administration is going all out to investigate the problems of a man moving around in space outside his craft.

Scarcely a month after releasing a 200-page report on astronaut safety lines, NASA has published an even longer document, this time devoted to staying under control while maneuvering in free space. The title reads, "A study of an attitude control system (ACS) for the astronaut maneuvering unit (AMU)."

With no gravitational pull to indicate up and down, astronauts will have to use their spacecraft or space stations as reference points for moving about. One of the biggest problems covered by the report is the difficulty of aiming the jet of gas or compressed air that will probably provide push.

Control units of all types were investigated, operated by the astronaut's hand, foot, leg, head, body, tongue, lips, and even by movement of the eyeball. The tiny electrical currents produced by moving a muscle could be amplified and used to control the AMU directly, making it a true extension of the body.

Perhaps in case an astronaut might like to hum while he works, another system considered would respond to different musical notes. The trouble with that, said the report, is that the necessary musical ability is "not naturally possessed to any marked extent by the average astronaut, not easily acquired and not functionally dependable in an emergency."

A spaceman unable to carry a tune in a bucket might still be able to play the harmonica, the researchers thought. This, then, was the model for a breath-operated controller that was finally rejected because, among other reasons, a man's breath control is "not very precise by normal engineering standards."

Body English would be the key to a torso-operated system responding to movements like leaning to one side or bending at the waist. However, since the propulsion unit is fastened rigidly to the wearer's back, severely limiting body movement, an astronaut using the system would find himself forced to do something like the Twist while floating in space, a rather awkward process while trying to work at this same time. In addition, there is danger of a vicious circle being set up in which the astronaut would move his body, causing the control unit to fire the propulsion system, which in turn would jar the astronaut's body again, firing the propulsion system again, etc. . . .

The most foolproof way to control the system, concluded the researchers, is by spoken commands. A vocabulary of 10 words could be used in various combinations to give the 36 commands needed for complete control. Speech-recognition machines already exist, but in relatively primitive forms. However, computer-simulation of a speech-operated unit indicated that the technique works well and removes the need for physical control.

What kind of propulsion unit is going to be controlled by all these strange controllers?

The five researchers, scientists at Honeywell Inc., Minneapolis, Minn., working under a NASA contract, decided on a 190-pound backpack measuring 36 inches high, 18 inches wide and 8 inches thick. Most of the 190 pounds consisted of eight jet engines, mounted so as to enable the wearer to push himself in any direction.

Any unit using jet engines must, of course, be designed so that the "pilot" will not accidentally put a hand or foot in the way of the blast.

"Jet location should be compatible with the anatomy of the astronaut," said the report, "and . . . should minimize the possibility of the jet's impinging on the astronaut's gloves or other regions of the pressure suit."

When moving around in space, any movement can cause a reaction such as going into a spin in the other direction. Therefore, the study had to consider such factors as the effect of free-swinging legs on the momentum of the astronaut. At one point, the symbol "k" was used to represent the "torsional spring constant of the hip joint."

A special study was recommended by the scientists to evaluate the use of the unit for traveling on the surface of the moon.

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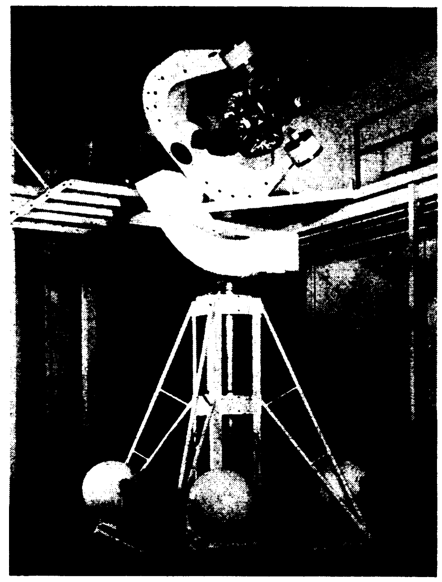

General Dynamics

FRICTION-FREE FLOATING—The 15-foot-tall weightlessness simulator under development by the Convair division of General Dynamics Corporation, San Diego, permits a person to float in midair, virtually free of friction in all directions including rolling, tumbling and spinning. The vehicle will be used as a tool for studying spacecraft design requirements.

SPACE

Timers Quiet Satellites

➤ VANGUARD 1, the fourth man-made object put into orbit (March 17, 1958), is still transmitting data after more than seven years, whenever it is in sunlight. Scientists would like to put a stop to this.

Since 1960, automatic cut-off timers have been built into most U.S. satellites so that they will not tie up more than their share of time on the limited number of radio frequencies available for telemetry.

Pegasus, for example, an accordion-pleated micrometeoroid-detection probe with a 96-foot "wing"-span, was launched last Feb. 16, and began sending back streams of data. On Feb. 16, 1966, a tiny electronic device, powered by its own battery independently of the satellite power supply, will shut off the current to the transmitters, leaving Pegasus to orbit in silence.

The timers, including a second one for a backup, aboard Pegasus, as well as those of Telstars I and II, are built around tiny tuning forks, whose unvarying vibrations provide an accurate base for time measurement. They were developed by Bulova Watch Company, Inc., and are called Accutrons.

As more and more data-collecting satellites are launched into space, the restrictions on their transmissions will have to be increased. One approach may be to expand the number of usable radio frequencies into areas now vacant.

Another idea being considered by space scientists is one that has already been used on a limited scale: instead of sending continuous streams of data down to earth, satellites would tape record their own information over an extended period of time, then send it at ultra-high speed upon a signal from earth. This technique has been used on the Orbiting Solar Observatories (OSOs), but not because of crowded frequency bands. During the larger part of the OSOs' orbits, they were out of radio range from earth. Therefore, they saved up their data until they were relatively nearby, and then sent it all at once.

The Mars-bound Mariner spacecraft, which will take 22 or 23 pictures of Mars in mid-July, will use a tape delay system for still a different reason. The television camera making the pictures will be feeding in a signal at 10,700 bits per second, while the telemetry playback rate at that great distance is limited to 8.33 bits per second, a ratio of 1285 to 1.

In order to slow down the signal before it is transmitted to earth, all the pictures will be recorded at once, and then the whole series will be "played back."

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