Space TECHNICAL INFORMATION DIGEST

SPACE SYSTEMS INFORMATION BRANCH, GEORGE C. MARSHALL SPACE FLIGHT CENTER

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PRECISE GONIOMETER ANNOUNCED. A new instrument that measures angles to an accuracy of 0.10 sec of arc has been delivered to NASA's Marshall Space Flight Center. The device, developed by Link Division of General Precision, Inc., utilizes interferometric techniques. It will be used by Marshall's scientists and engineers to calibrate other precision instruments and to measure and monitor drift of precision gyroscopes intended for use in space vehicles. Called the Fringecount Gonimet, it is the first production unit of a prototype used by Johns Hopkins University to accurately determine atomic dimensions of crystals. The new device could be used to aim a laser beam to less then 0.9 m (3 ft) at a satellite in a 1600-km (1000-mi) high orbit.

As is its forerunner, the length-measuring Fringecount Micrometer, the new instrument is an electro-optical instrument that uses a basic physical constant, a wavelength of light. Its operation is based upon the generation and counting of light interference patterns in response to changes in relative orientation of two independently mounted assemblies, a gonior and a sensor. The stationary sensor contains the major components of the interferometer, which transmits two collimated light beams to the gonior. The gonior, with a pair of reflectors, provides the change in optical path length with rotation. The new device measures the angle from a position of the gonior at which the difference in optical path length of two interfering light beams is zero. (Source: Data supplied by Link Division, General Precision, Inc.)

60-LB THRUST ROCKET DEVELOPED FOR MANNED SPACECRAFT ATTITUDE CONTROL. Development of a high performance, 27-kg (60-lb), pulse-modulated thrust rocket for space vehicle attitude control systems has been announced by Vickers Incorporated Division of Sperry Rand Corporation (Fig. 1).

A major objective of the development program was a pulse rocket offering the inherent reliability necessary for manned space flight. The single-solenoid concept is aimed toward reliable synchronization of the bipropellants N_2O_4 and N_2H_4-UDMH. Redundancy of electrical components is provided by the use of two independent coils in the solenoid. High response is obtained by minimizing the space between the valve seats and injector, and by maintaining close integration between the solenoid, propellant valves, and combustion chamber. (Source: Data supplied by Vickers Inc., Sperry Rand Corp.)

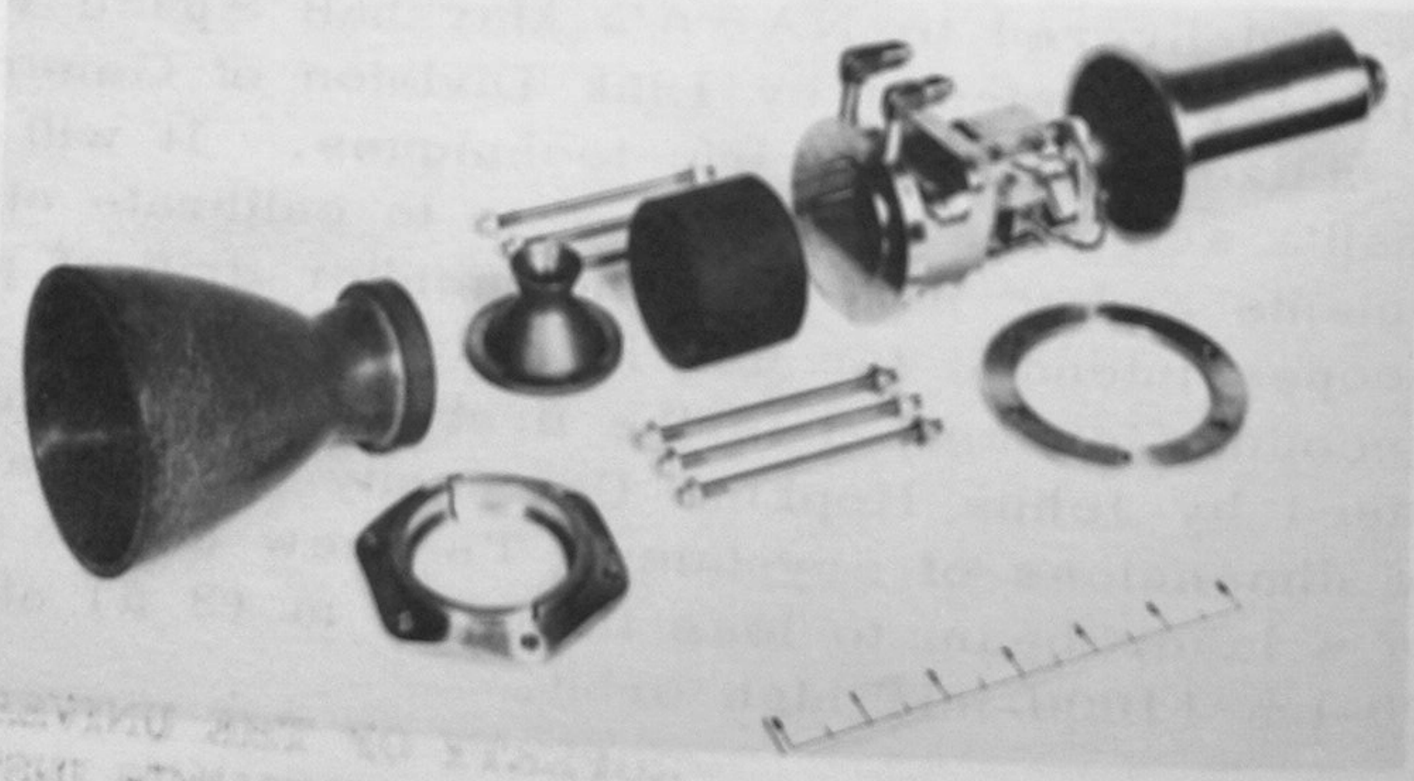

FIG. 1

THIN-FILM DIGITAL EQUIPMENT DEVELOPED. The Microelectronics Laboratory of Kearfott Division, General Precision, Inc., has combined solid-state technology and well-established conventional electronics capability with digital equipment and the full requirements of analog applications. From this approach has been developed the hybrid technique, termed MicroBloc.

This new concept combines the advantages of reduced cost, size, and weight of thin-film circuitry with the high-performance capability of conventional circuitry. In addition to solving the major technological problems involved, the process provides an economical means of producing various circuit complexities in small quantities for analog equipment. The technique employs thin-film resistors and capacitors deposited on a ceramic substrate with subsequent addition of discrete, active transistors. A direct result of this technique has been the development of a 5-w, 4.1-cm^3 (0.25-in^3) servo amplifier (Fig. 2 and Fig. 3) that is hermetically sealed and meets the requirements of military specifications for standard units of the same performance capability. This amplifier has solved the "heat-transfer" problem that previously plagued thin-film amplifiers designed for analog equipment.

Through this new technique, a whole new scope of capability has been opened in supplying microelectronic circuitry for analog applications. The laboratory can provide components that are best suited to a particular application without resorting to the expediency of conventional technology. In addition, the new technique equips the laboratory with high-volume production capability. (Source: Kearfott Division, General Precision, Inc.)

HELIUM BELT REPORTED IN UPPER ATMOSPHERE. The Earth's upper atmosphere contains a belt of neutral helium at an altitude of from 240 km (150 mi) to 970 km (600 mi). This recent discovery, gathered from Explorer 17 data, adds new complexity to previous thinking that a band of oxygen and nitrogen gradually merged into an interplanetary atmosphere of hydrogen. The report was based on preliminary findings from Explorer 17 data as presented by Goddard Space Flight Center scientists at a recent meeting of the American Geophysical Union. (Source: New York Times, April 19, 1963)

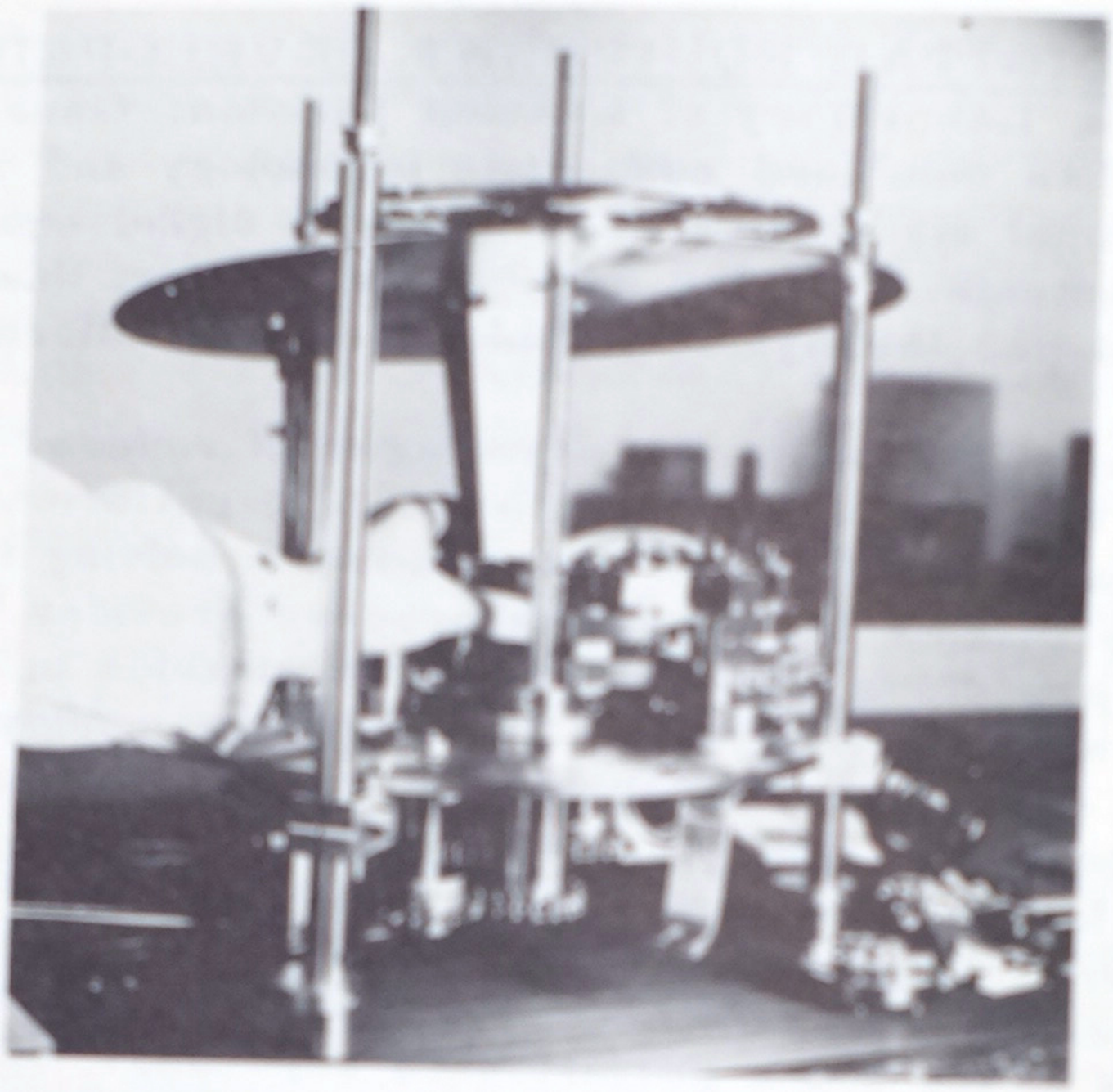

FIG. 2

FIG. 3

NASA PLANS FOR IQSY SPACE RESEARCH. (This article is a condensation of portions of a NASA report that describes the contributions of space research in the International Years of the Quiet Sun, 1964-65.)

Among the major contributions of NASA to the International Years of the Quiet Sun (IQSY) is the study of the Sun itself. The short-wavelength portion of the Sun's spectrum will be mapped and monitored in the ultraviolet for the entire Sun and for selected regions of interest. Several X-ray and gamma-ray energy regions will also be monitored, as will X-ray surges and similar activity in the 2-4 Mc/sec radio region; the white-light corona will be frequently mapped.

Other important experimental measurements will be made of the ionosphere and the atmosphere of the Earth; data will be provided on the solar plasma in the Earth's vicinity; trapped radiation will be measured to determine its characteristics; both solar and galactic cosmic rays will be studied and measured; and similar measuremenis of other Sun-emitted particles will be made. Direct measuremenis of the Solar System's magnetic fields will be performed, along with extensive mapping of the geomagnetic field by satellites with highly eccentric orbits--from 100 km (62 mi) to 300,000 km (186,000 mi). Studies of cloud cover in detail will be carried out by spacecraft in polar orbits equipped with television cameras and infrared sensors. The NASA flight program for these experiments is shown in Table 1. (Source: International Geophysics Bulletin, No. 67, January 1963)

SUBLIMING SOLID MOTOR DEVELOPED. A subliming solid microrocket that produces small forces to control satellite and space vehicles has been developed by Rocket Research Corporation. It uses a new kind of solid propellant, Sublex, which can be turned on and off at will. Use of this propellant does not involve the usual rocket problems of ignition, combustion, high temperature, and high pressure.

The system consists of the propellant, tank, and valve (Fig. 4). Simplicity tends to result in high reliability, an attribute of major importance for systems that must operate in outer space for millions of cycles. Another significant feature is low weight; the subliming solid system is about half the weight of current control systems using nitrogen.

Table 1. NASA Flight Program for the IQSY Period of Solar Minimum

	Number of Vehicles**			
	1963	1964	1965	1966
Sounding Rockets	100 s	150 s	150 s	150 s
OSO	2 s	1 s, 1 uc	2 uc	2 uc
IMP	1 s	2 s	2 uc	2 uc
Pioneer		1 uc	4 uc	4 uc
EGO	1 s		2 uc	1 uc
POGO		1 s, 1 uc	2 uc	1 uc
Mariner R		2 s	3 uc	
Mariner B*			2 s	3 uc
Surveyor*				
Lander		2 s	5 s	5 uc
Orbiter		1 uc	3 uc	3 uc
Ionosphere Explorers and Monitors	1 s	1 s	1 uc	2 uc
Atmospheric Structure Satellite	2 s		2 uc	2 uc

* Under Review
**s = scheduled (number of sounding rockets are approximate)
UC = under consideration

Opening the valve allows the solid propellant to vaporize to a gas which then escapes through the valve into the vacuum of space, producing a thrust. When the valve is closed, vaporization ceases. (Source: Data supplied by Rocket Research Corp.)

SPEAKER OUTLINES MANNED MARS MISSION. If America is to land men on Mars during 1973-75, when the planets next arrive at their most favorable positions, the key decisions must be made now while there is still time to develop the space systems and techniques required. This opinion was stressed in a speech delivered in Dallas, Texas, on April 24 to a national meeting of the American Institute of Aeronautics and Astronautics. The speaker, Krafft Ehricke, said Earth and Mars will not again be in such favorable positions before 1984.

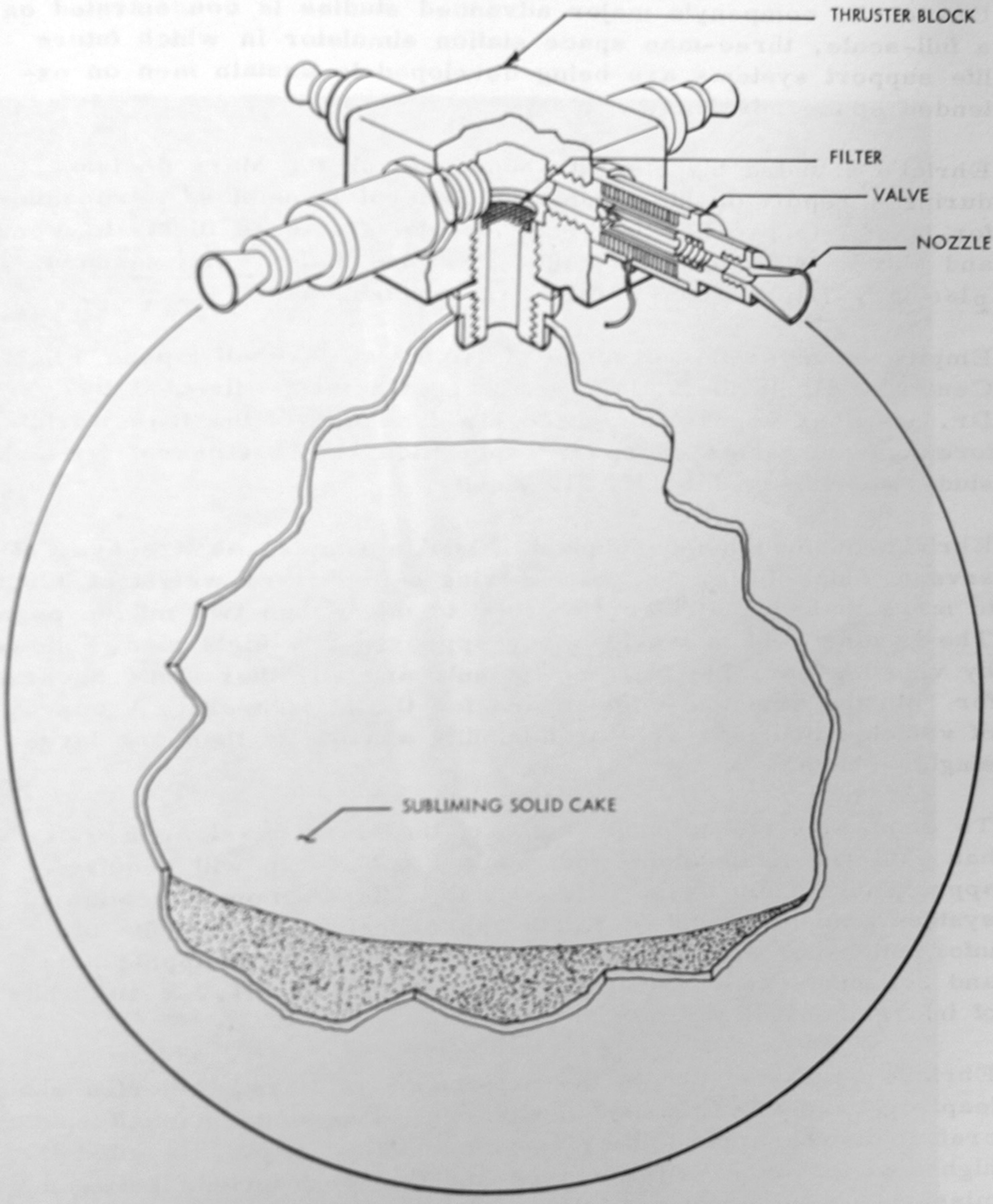

FIG. 4

Ehricke is a space research scientist and the Director of Advanced Studies at General Dynamics/Astronautics in San Diego. One of the company's major advanced studies is concentrated on a full-scale, three-man space station simulator in which future life support systems are being developed to sustain men on extended space missions.

Ehricke sounded his eleventh-hour note on the Mars decision during a report on his studies at General Dynamics/Astronautics for NASA to provide the requirements of manned flights to Venus and Mars. The study is called "Empire," for early manned planetary-interplanetary roundtrip expedition.

Empire is under the direction of NASA's Marshall Space Flight Center at Huntsville, Alabama. The Center is directed by Dr. Wernher von Braun, recognized as one of the free world's foremost authorities on space exploration. The General Dynamics study was directed by H. H. Koelle.

Ehricke outlined his concept of NASA's Empire as a convoy of several ships (Fig. 5), each having a departure weight of 320,000 to more than 9×10^5 kg (700,000 to more than two million pounds). The leading vehicle would carry approximately eight men, followed by vehicles carrying fuel, equipment, and all other items necessary for both the scientific mission and for the flight itself. A convoy of vehicles provides greater flexibility and safety than one large single vehicle.

To emphasize the scientific value of the Mars mission, Ehricke has said his computations indicate the round trip will require approximately 400 days. He said the Empire communication system would transmit to Earth approximately 50,000 bits of information per sec during the mission, including mapping data and scientific experimental results, for a total of 1.7×10^{12} bits of information.

Ehricke suggested that in the exploration of Mars, America should leapfrog the fly-by mission and attempt to send its manned spacecraft into orbit around the planet on the first trip. He cited the high cost for either mission type and the long periods between missions as his reasons. He said that, in his opinion, an orbital mission would not be significantly more difficult than a fly-by, while yielding a significantly greater return in terms of planetary reconnaissance and for the preparation of a major landing mission.

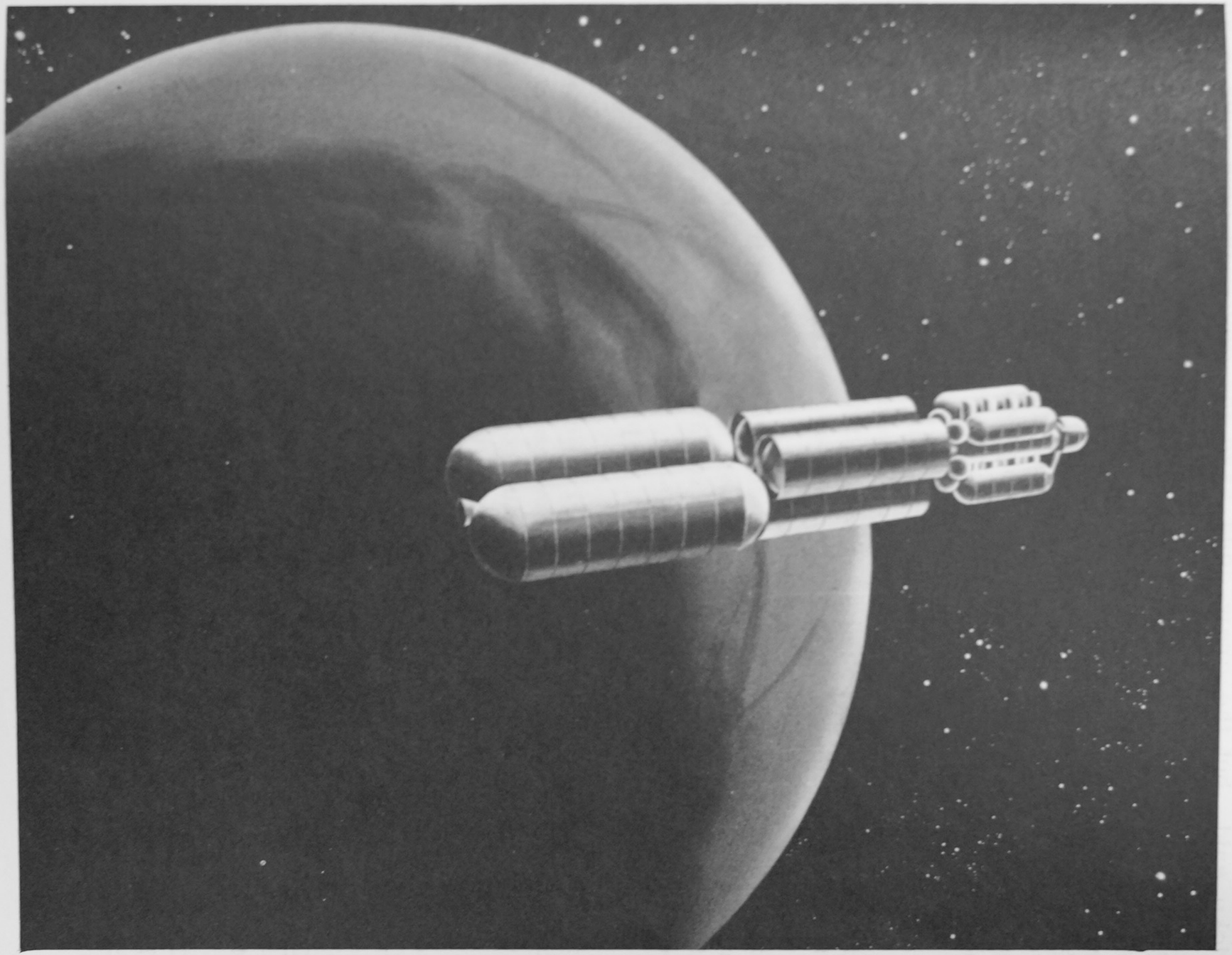

FIG. 5

The Empire convoy units, assembled in space, would include vehicles that could be detached on arrival for services such as terrain mapping, crew landing, balloon probes for atmospheric data, television transmission to Earth, and "search-for-life" instrumentation. It would not be practical to establish a Mars base on the first mission, Ehricke said, but the crew could have the option of detaching a surface excursion vehicle from the convoy for a brief visit to Mars' surface.

Space "taxis" would commute between convoy vehicles, serving as "tugboats" to move fuel tanks, interchange parts to make repairs, or cut-out units to be sacrificed in the event of damage. The taxis could serve as rescue vehicles to move the crew to another vehicle if their own was damaged.

Ehricke said preliminary analysis of the Empire concept indicates that a not-too-ambitious mission to Venus or Mars in 1973 or 1975 is "in the realm of realistic technological planning." He said the most critical technical item is the nuclear engine requirement.

Ehricke lauded NASA for what he termed a "sound, scientific approach to the problems" of manned interplanetary travel, and for its understanding of the nature of man which compels him to explore his universe personally. Man never will be satisfied to rely on instrument probes alone to inspect other planets, he said.

Ehricke once wrote that "If one traces the evolution of life from its birthplace in the sea, and examines the growth of man down through the ages as each succeeding civilization has gazed at its starry sky, one cannot ask, 'Why go to other planets?' Rather, one must see that the desire to expand to the limits of the inhabitable universe is life's most powerful impulse." (Source: Data supplied by General Dynamics/Astronautics)

TECHNICAL REPORTS AVAILABLE. The following listed technical reports can be requested through the NASA library, M-MS-IPL, Bldg. 4481.

NOTE: Those reports with an AD number may be on file in the local DDC branch in Bldg. 4484. Readers can save time by calling 876-6088 and inquiring if such reports are available before ordering them through NASA.

1. HIGH RESOLUTION CATHODE RAY TUBE, H. Moss et al. AD 291 824
2. NEW CATHODE-ANODE COUPLES USING NONAQUEOUS ELECTROLYTES, J. E. Chilton and G. M. Cook. AD 286 889
3. THERMAL RADIATION INCIDENT ON AN EARTH SATELLITE, F. E. Swalley. NASA N63-11121
4. SPACE-CHARGE-FLOW THEORY AND ELECTRODE DESIGN FOR ELECTROSTATIC ROCKET ENGINES, D. L. Lockwood and Vladimir Hamza. NASA N63-10735
5. THERMAL RADIATIVE PROPERTIES OF SELECTED MATERIALS, W. D. Wood et al. AD 294 345
6. DETERMINATION OF ENGINEERING PROPERTIES OF MAR-STRAINED STEELS, R. E. Yount. AD 289 609
7. USE OF DEPLETED URANIUM IN BEARING METALS AND LOW ALLOY STEELS. TID 8212
8. SULFUR HEXAFLUORIDE IN HIGH POWER MICROWAVE SYSTEMS, Vincent Vannicola. AD 289 854
9. THERMAL ANALYSIS OF A SUPERCONDUCTING GENERATOR, R. J. Smith. AD 288 917