Space TECHNICAL INFORMATION DIGEST

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

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<u>LITTLE JOE-APOLLO</u>. NASA Manned Spacecraft Center's Little Joe 2 (Fig. 1), a solid-fuel launch vehicle, will be used to launch NASA's Apollo spacecraft on unmanned, suborbital test flights for evaluation of the Apollo launch escape system. Project Apollo is the nation's multi-manned spacecraft development program designed to place American astronauts on the Moon during this decade. The Little Joe 2 will be designed and built by General Dynamics/Convair, of San Diego, under a NASA contract managed by the Manned Spacecraft Center in Houston.

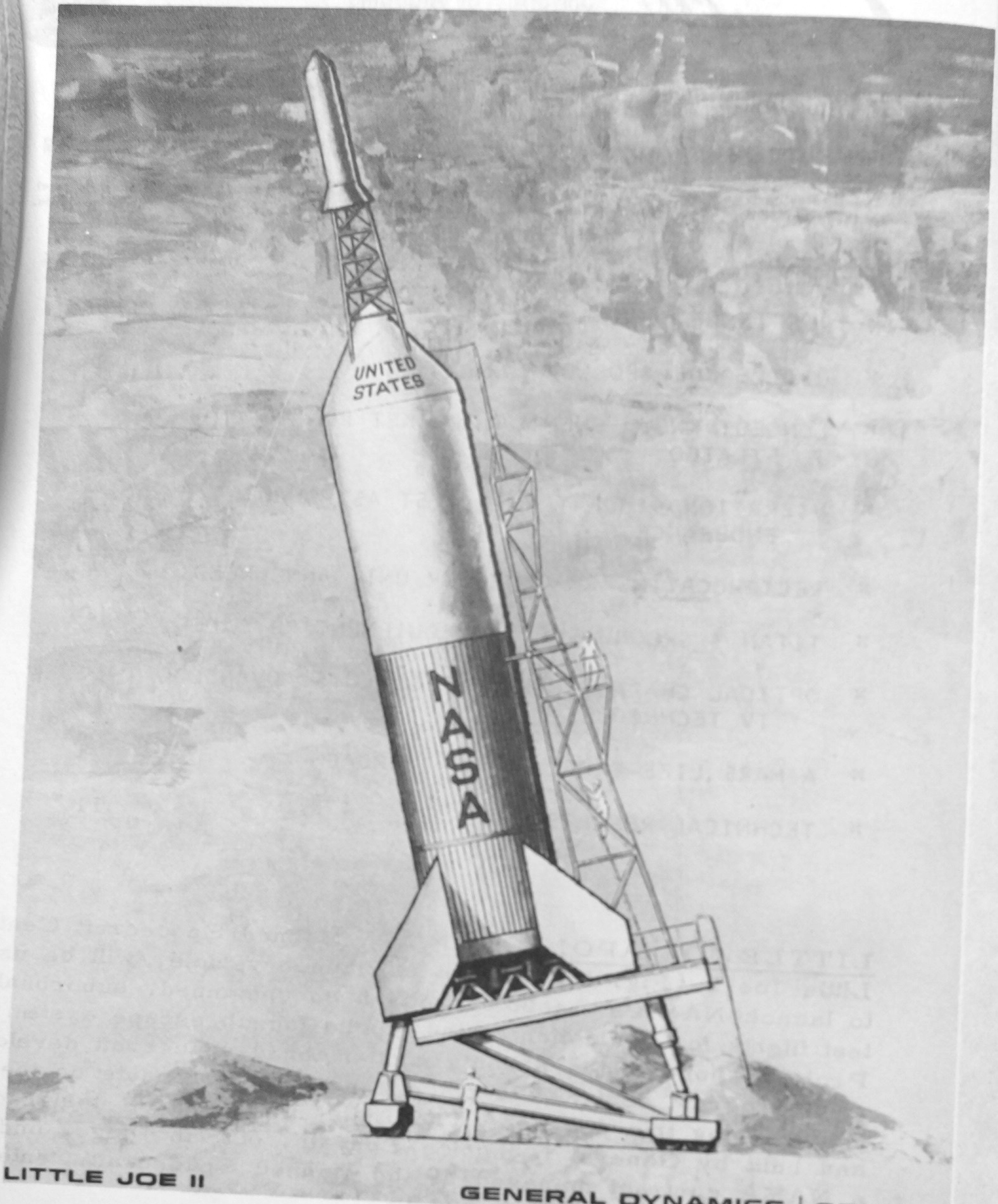

FIG. 1

Shown in an artist's conception (Fig. 1), the launch vehicle (dark section) is topped (light section) by a test unit composed of the service module, the Apollo spacecraft, and the launch escape tower. The test system stands about 31 m (103 ft) tall and weighs about 100,000 kg (225,000 lb); the launch vehicle stands 13 m (43 ft) tall. The barrel-shaped body is 4 m (13 ft) in diameter.

The first Little Joe 2 launch vehicle will be delivered by the contractor to the launch site in 1963. (Source: Photograph and caption supplied by NASA)

LONGEST KNOWN CHEMICAL ROCKET RUN DEMONSTRATED. The longest known continuous firing of a chemically fueled control rocket engine is announced by The Marquardt Corporation. A 0.09-kg (0.2-lb) thrust radiation-cooled engine was run steadily in a test for 17 hr, 22 min--considered more than sufficient for extended duration space missions.

The rocket is an auxiliary propulsion system for attitude control of space vehicles and satellites during space flight, rendezvous, orbital correction, station keeping, and other maneuvers requiring accurate and economic positioning in space. Thrust duration requirements for such maneuvers depend upon the specific space mission and can range from milliseconds to hours.

The rocket, a bipropellant hypergolic (self-igniting) system, was subjected to a series of test firings to demonstrate its ability to generate precisely controlled increments of thrust. The tests demonstrated the high reliability and accuracy of the system. (Source: Data supplied by The Marquardt Corporation)

VIBRATION SIMULATOR TO TEST ASTRONAUTS' ENDURANCE. A six-degree-of-motion simulator will be installed at Wright Patterson Air Force Base next year to test astronauts' reactions to the severe vibrations of launch and reentry. The tests are designed to find out more about the tolerance of the astronauts to some actual flight conditions.

The simulator study was conceived after the discovery of severe linear and angular oscillations during the launch and reentry of space vehicles, low-altitude aircraft flight, and escape system operation. A feasibility study was begun by MB Electronics, under the sponsorship of NASA and the Aerospace Medical Laboratories, to examine the concept of the simulator. Before the new simulator becomes operational, no other apparatus will be available for subjecting astronauts to the simultaneous linear and angular stresses of spacecraft operations.

Seven powerful hydraulic "shakers," each with 11,500 kg (25,000 lb) of force capacity, are connected to a 2.34 m^2 (25 ft^2) test platform by pushrods and universal joints. Power for the shakers is supplied by 1400-hp hydraulic pumps which pump 2.73 m^3 (720 gal) of oil per min at 216 kg/cm^2 (3000 psi).

The shakers will be controlled electronically; inputs may be selected from a 7-channel tape recorder, 6 function generators, and a random noise generator. Input signals may be applied in any combination through a patch panel.

Before space pilots are given a ride on the "shake table," artificial human equivalents and monkeys will be given the simulator test. The astronauts, clothed in space suits, will lie on space vehicle couches during the tests. The astronauts will be asked through earphones to operate various mock controls in the mock cabin. Close observation of their reactions and results could lead to an ideal control arrangement for the worst possible flight conditions. Human tolerance levels for many severe and complex vibration conditions will provide designers with information for the proper design of seating and restraining devices, to name two examples. (Source: Test Engineering, December 1962)

RECIPROCATING SPACE POWER UNIT ANNOUNCED.

Marquardt Corporation has announced a development program for an internal-combustion space power unit. An approach to a reciprocating space power unit (SPU) has been studied for several years (Fig. 2); this concept has been termed suitable for space missions of the near future. As an electrical power source, it has applications that include space stations, lunar power stations, and many space vehicles.

Development of a feasible hypergolic SPU under the auspices of NASA may result in the first such power generator using rocket bipropellant fuel. In support of the SPU system are lower fixed

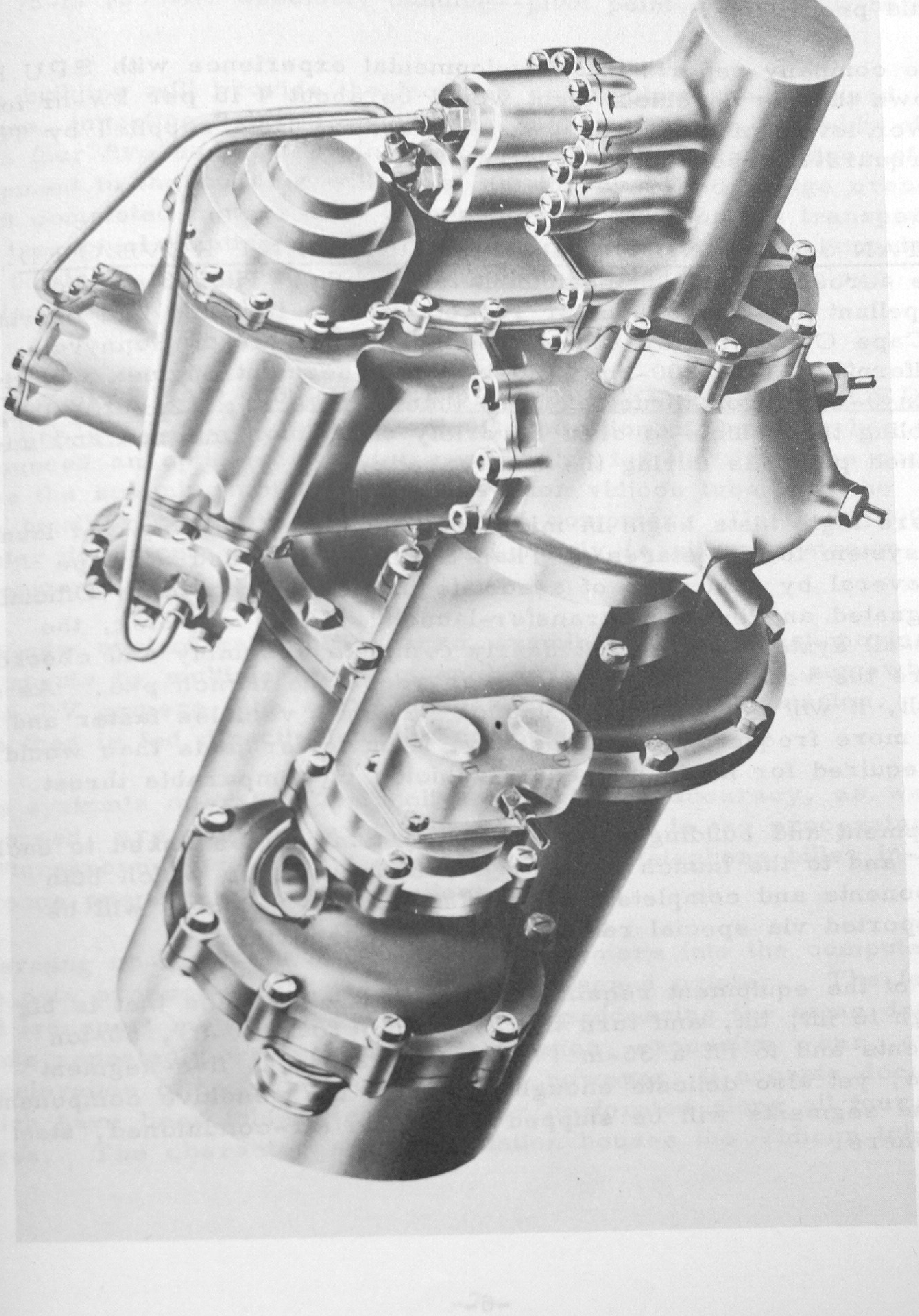

FIG. 2

weight, compactness, and economy when compared with reactors or fuel cells. The engine is to be based largely upon the established technologies of internal combustion engines and storable liquid propellants.

The company reports that developmental experience with SPU has shown that its specific weight would be about 4 lb per kw-hr for power levels of 0.5 to 30 kw. (Source: Data supplied by The Marquardt Corporation)

TITAN 3 GROUND SUPPORT EQUIPMENT REVEALED.

The aerospace ground equipment for handling Titan 3's solid-propellant first-stage booster rockets will be installed and operated at Cape Canaveral by United Technology Center of Sunnyvale, California. Two 300-cm (120-in.) five-segment engines will give Titan 3-C a liftoff thrust of more than 9×10^6 kg (2×10^6 lb), enabling the vehicle to orbit a variety of multiton manned and unmanned payloads during the next decade.

Before flight tests begin in mid-1965, a unique handling and launching system for all stages of Titan 3 will be installed at Cape Canaveral by a number of associate prime contractors. Officially designated an "integrate-transfer-launch" (ITL) complex, the over-all system will permit nearly complete assembly and checkout before the vehicle and payload ever reach the launch pad. As a result, it will be possible to launch Titan 3 vehicles faster and with more frequency, if necessary, from fewer pads than would be required for liquid propellant vehicles of comparable thrust.

Equipment and buildings of the ITL system will be linked to each other and to the launch pads by a rail network on which both components and completely assembled Titan 3 vehicles will be transported via special rail cars, or "transporters."

Most of the equipment required is the first of its kind that is big enough to lift, tilt, and turn the 3 x 3-m (10 x 10-ft), 50-ton segments and to lift a 35-m (75-ft) tall, 250-ton, five-segment engine, yet also delicate enough to handle the sensitive components. Engine segments will be shipped by rail in air-conditioned, steel containers.

After their arrival, segments and inert components (nozzles, thrust vector control tanks, and motor skirts) will be moved by transporter through a series of receipt, inspection, and storage buildings to a 75-m (250-ft) assembly building--pivot point of the ITL complex.

This building will provide the facilities and equipment--overhead cranes, inverting fixtures, and lifting harnesses--for assembly of up to four five-segment engines at a time. The biggest piece of equipment in the building will be a 300-ton overhead bridge crane to lift completed motors onto transporters. It is on the transporters that the actual "mating" of the solid and liquid propellant elements will be done. (Source: Data supplied by United Technology Center)

<u>OPTICAL CHARACTER READER EMPLOYS ADVANCED TV TECHNIQUES</u>. The Radio Corporation of America has announced an optical character reader that for the first time combines the scanning ability of the television vidicon tube with the data handling capacity of the RCA 301 computer. Up to 90,000 printer documents can be processed hourly (a six-mile stream of paperwork).

The new system, called Videoscan, examines data on fast-moving documents by multiple scans of each printed character, somewhat as a TV camera tube scans scenes for picture transmission. The data then is fed directly into the computer.

The system's operating simplicity and extreme accuracy, as well as speed, are said to be of prime importance in the processing of "turnaround" statements such as gas and telephone bills, insurance premiums, and tax notices.

Operating on-line, the device directly reenters into the computer live data produced by the system's high speed printer. The feed and transport mechanism is capable of processing the same documents repeatedly without causing mutilation, excessive wear, or discoloration of the scanning surface; however, it accepts documents which have been folded, creased, or perforated along all four edges. The character scanning station houses the Vidicon tube.

Documents can range in size from 6.4 cm (2.5 in.) to 22.4 cm (8.5 in.) in width, 6.4 to 10 cm (2.5 to 4 in.) in height and from 0.0076 to 0.025 cm (0.003 to 0.01 in.) in thickness. Sizes less than 10 cm (4 in.) in width can move down the transport track at the rate of 1500/min. A switch on the transport console provides speed selection.

As the paper or card form moves past the character scanning station, a concentrated light is directed on the character being read. Reflected light from the surface of the form is bounced through a lens onto the target surface of the vidicon tube. The electron beam of the tube examines the area under scrutiny in a series of vertical "searches." The signal produced by each vertical sweep is fed to a video processing unit and is converted to a digital signal. These signals are relayed in rapid fire order to a character feature recognition device which compares the accumulated data with its "library" of character patterns for final identification. The completed character signal is converted to computer code, and the information is sped along to the electronic data processor.

Characters recognized by the device consist of the basic numerals 0 through 9 and special symbols including the period, dash, asterisk, dollar sign, and pre-printed or pencil-made vertical marks to suggest data segments for processing. Letters can be employed when converted to a two-digit equivalent. Up to 79 characters on a single line can be handled.

With the inclusion of an optional solar cell mark reader, the system will make electronic note of properly positioned vertical marks made on documents by pen or pencil, as well as other printed data. The sensed vertical marks are translated into digital input code for the data system.

The system can be operated either as an on-line device working directly with the computer or in performing off-line to segregate documents requiring special attention. (Source: Data supplied by Radio Corporation of America)

<u>A MARS LIFE-PROBE: ONE APPROACH</u>. A way to detect life on Mars in early probes of the planet is described by G. W. Levin, et al., writing in the journal <u>Science</u> (Vol. 138, No. 3537).

Their approach is to use the very sensitive radioisotope technique for the detection of gas evolution, "a common product of metabolism."

Called "Gulliver," the concept would use a 0.68-kg (1.5-lb) instrument mounted inside the instrument capsule of the vehicle. While still some distance from Mars, the capsule would be ejected into a capture trajectory. The main body of the Mars probe would still be able to carry out its original design functions.

The instrument itself would contain soil-sample retrieval equipment, a radioactive "broth chamber" to provide the immersing fluid for the retrieval lines, and a detector for solids (Fig. 3). After parachuting to a soft landing on Mars, the ampule containing the radioactive broth is broken; at the same time, a weak-acid ampule is broken. The acid then generates nonradioactive CO_2 from an adjacent carbonate or bicarbonate. Low levels of $C^{14}O_2$ already generated during the voyage are flushed and vented to the Martian atmosphere.

During the flushing operation, two projectiles, each with 7 m (23 ft) of sample-collection line, are fired across the planet's terrain. These lines are impregnated with silicone grease for picking up particles; the lines are later wound on a reel into a culture chamber. A port is opened in the culture chamber to accept the retrieved lines. This permits the interior environment to stabilize with the local environment, except that the temperature of the medium will be kept slightly above its freezing temperature.

After line-retrieval, the chamber is sealed, a background count of the chamber is made, and the radioactive broth is transferred to the culture chamber to immerse the retrieval lines.

The $C^{14}O_2$ evolved in the culture migrates to a beta detector (coated with barium oxide) mounted immediately above the culture chamber. Radioactivity accumulated on the detector is read by a scaler, and at 15-min intervals is relayed directly to Earth by radio transmission.

The evolution of $C^{14}O_2$ from radioactive substrates to indicate microbial metabolism and growth has already been investigated and developed; an instrument based on the Gulliver approach has been used with success in field testing. However, further refinements in the system are being studied. For example, a principal change is to devise an instrument that will function in any chance attitude that the instrument may assume after landing on Mars. (Source: Science, October 12, 1962)

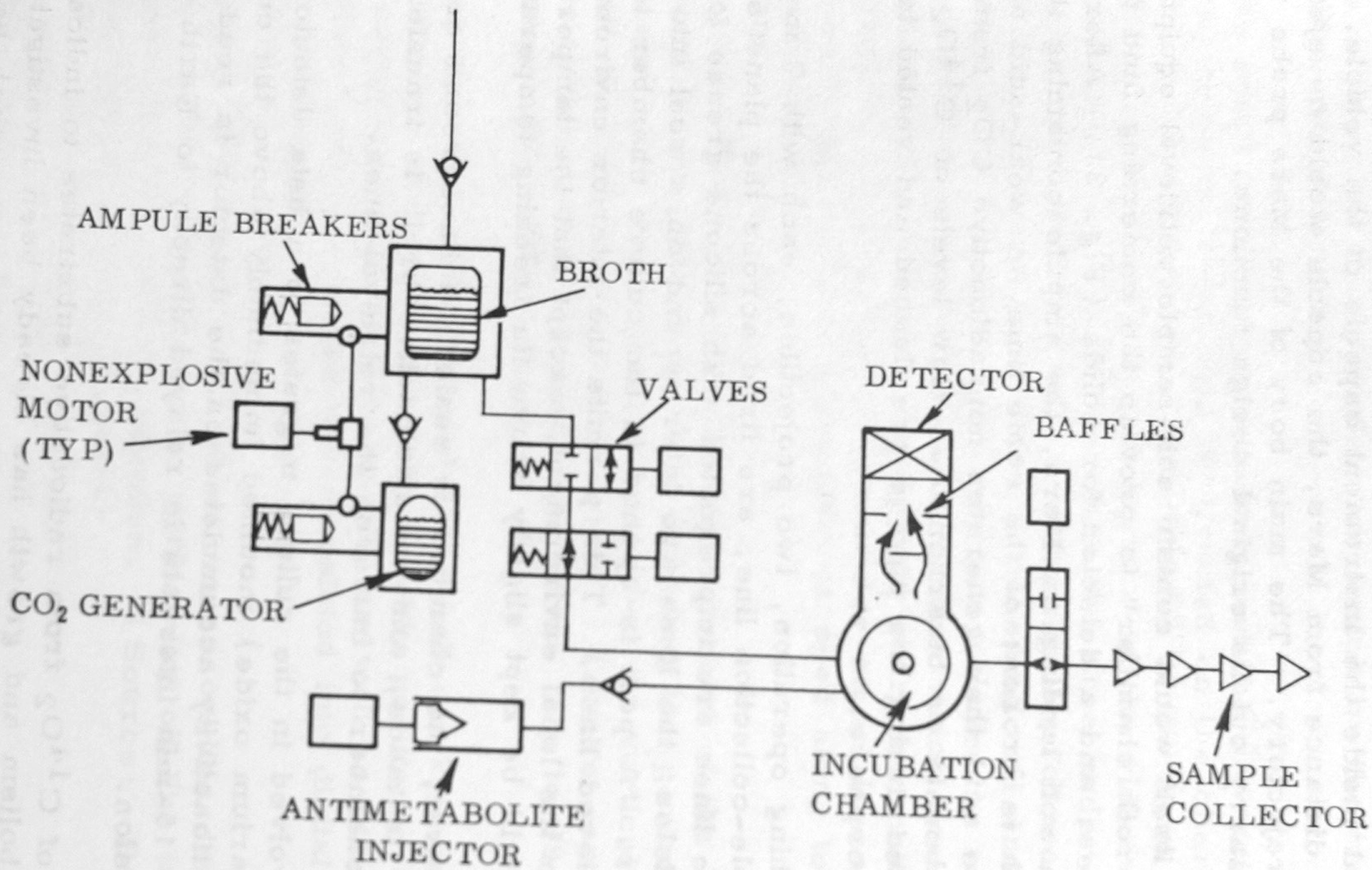
AMPULE BREAKERS
BROTH
NONEXPLOSIVE
MOTOR
(TYP)
CO_2 GENERATOR
VALVES
DETECTOR
BAFFLES
INCUBATION
CHAMBER
SAMPLE
COLLECTOR
ANTIMETABOLITE
INJECTOR

FIG. 3

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 ASTIA 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. SUPERCONDUCTIVITY IN METALS AND ALLOYS, W. H. Cherry et al. of RCA. AD 286 456
2. THERMAL RADIATION PROPERTIES OF MATERIALS, R. A. Seban. AD 286 863
3. ELECTROCHEMICAL LIGHT MODULATOR, J. F. Aitken. AD 283 118
4. THE DYNACELL AND FOCAL PLANE CONCEPTS OF PHOTOTROPIC SYSTEMS APPLICATION TO OPHTHALMIC NUCLEAR FLASH-PROTECTIVE DEVICES, R. W. Harries. AD 284 059
5. PERCEPTION OF THE VISUAL VERTICAL UNDER REDUCED GRAVITY, L. R. Hammer. AD 284 050
6. MULTI-FIELD ELECTRONIC APPARATUS FOR STUDIES OF VISUAL PERCEPTION, P. A. Kolers. AD 283 943
7. SURFACE TEMPERATURE MEASUREMENTS WITH THERMOELECTRIC MATERIALS. AD 286 098
8. SNAP 7 PROGRAM, QUARTERLY PROGRESS REPORT NO. 6. MND-P-2483-6
9. DEVELOPMENT OF A NOISE EXPOSURE METER, N. N. Estes and J. J. Moore. AD 283 922
10. A QUANTITATIVE MODEL FOR LOUDNESS DISCRIMINATION, J. L. Stewart. AD 282 724