PHYSICS

Create Sun Matter

An apparatus is being built that will operate only 25 millionths of a second to create a small piece of sun material, neither solid, liquid nor ordinary gas—By Walter Wingo

➤ A DEVICE being built will use up power equaling 80% of all the rest of the country's power consumption at the time it is operating.

Fortunately, no one will notice the drain, for the device operates for only about 25 millionths of a second.

Purpose of the apparatus, being assembled by the National Aeronautics and Space Administration at the Langley Research Center, Hampton, Va., is to create a small piece of sun material.

Ninety-nine percent of the universe is believed to be made up of such material, which is neither solid, liquid nor ordinary gas.

Called plasma, many scientists consider it a fourth state of matter. It is most closely resembles a gas, but it is loaded with electrically charged particles. An essential characteristic of a plasma is that it conducts electricity.

The plasma in the corona, or outer atmosphere, of the sun is made up largely of electrons and protons of hydrogen atoms. The so-called solar wind is a constant outpouring of plasma from the sun's surface.

To simulate the corona, Langley technicians built a 10-foot tall bank of condensers that provide a 12-million-ampere current. The resulting super-fast reaction will produce a column of brilliant plasma that may be as hot as 36 million degrees Fahrenheit.

Such tremendous heat would incinerate any container for the plasma, so the plasma is suspended in a magnetic field having pressure a thousand times greater than that of the atmosphere at sea level.

During the tiny fraction of a second that the plasma is suspended, the power discharge into the plasma is 80 million kilowatts.

During the plasma's moment of creation and return to its neutral gaseous state, instruments will record its electromagnetic radiations, such as infrared, ultraviolet, X-rays and visible light.

Why all the concern over plasma?

For one thing, it is the subject of a relatively new and unexplored field of science, termed magnetohydrodynamics (MHD). Study of MHD is expected to reveal much about the nature of the solar system and about the universe.

There are three more practical reasons for the vigorous research into MHD:

1. It offers a way to accelerate gases to very high speeds for use in aerodynamic research, particularly for wind tunnel studies of problems involving the reentry of spacecraft into the earth's atmosphere.

2. MHD holds prospects of being able to propel spacecraft and generate power.

3. Research into harnessing the fury of the H-bomb, thermonuclear fusion, is heavily dependent upon MHD.

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PHYSICS

Fight Rocket Vibrations

➤ THE VIBRATIONS, strains and noises that a large rocket undergoes in flight are enough to knock down a bridge.

Figuring out ways to counter such stresses is the task of spacecraft dynamics specialists at the Langley Research Center in Hampton, Va., a branch of the National Aeronautics and Space Administration. Their problems are big, and so are their tools for solving them.

A rocket takes punishment even while it is standing quietly on a launch pad. Winds, steady and gusty, cause the rocket and its umbilical tower to shake, holding up launch operations and sometimes injurying delicate equipment.

Scientists are studying these effects in Langley's huge Transonic Dynamics Tunnel. They place large models of launch vehicles and their towers on a turntable so they can be rotated to receive wind streams from any direction.

At the moment a rocket's engine ignites, the shock on the vehicle is the same a fine watch gets when it is dropped to the floor. Added to this are pressures from the roaring noise of a lift-off.

Some of the noise is of such low frequency it damages buildings miles away.

As launch vehicles grow larger, the frequencies of the sound waves emitted by their engines become even lower. Many may be infrasonic, that is, below the audible range.

NASA is studying low-frequency sound and its effects on man, vehicles and surrounding structures with a 14-foot diameter speaker at Langley driven by a 20,000-pound hydraulic shaker.

Once aloft, a rocket is subject to the whims of strong and violent high-altitude winds. These winds are being studied from smoke trails emitted by sounding rockets fired from Wallops Island, Va., and Cape Kennedy, Fla.

They have revealed regions of intense turbulence and strong wind shears, which are layers of winds blowing in different directions at different altitudes.

Since the rocket is a flexible rather than a rigid body, the winds act to bend it. The control system may confuse the bending motion with the course and send commands that cause the vehicle to swing backward and forward like a pendulum.

At Langley, engineers have developed a facility that suspends spacecraft models in a wind tunnel with an electromagnet. The magnetic coil holds the model in an airstream without touching it.

The model experiences forces similar to those the actual spacecraft will encounter in free flight.

As a rocket continues its journey, sloshing about of remaining fuel could generate damaging forces. These forces are reduced by damping the fluid motions with various types of baffles, and by designing the control system to cut down its reaction to the sloshing.

Another problem being worked on is fuel-dome impact. It can happen if the engine is cut off while the vehicle is accelerating through the atmosphere. The remaining propellants suddenly are hurled forward, striking the top of the fuel tanks. Sometimes the tanks burst.

Considerable research is in progress to solve the strange up-and-down motions, called Pogo oscillations, noted on numerous flights of liquid propellant launch rockets. The motions are troublesome for delicate payloads, including astronauts.

Still more problems occur when the space vehicle is in the near-vacuum above the earth's atmosphere.

To study these, Langley researchers use a vacuum chamber 68 feet tall and 55 feet in diameter in which altitudes up to 70 miles can be simulated.

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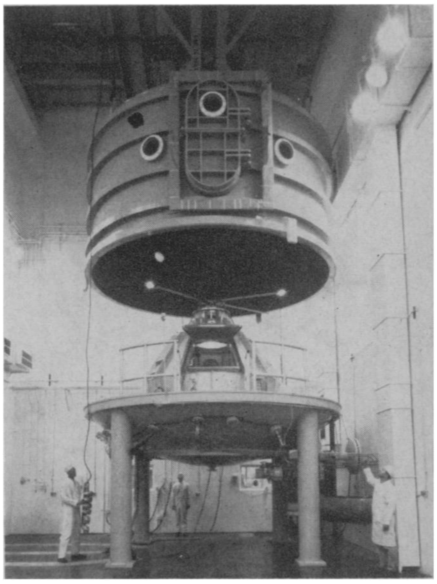

North American Aviation

LIVING IN SPACE—Scientists prepare the huge vacuum chamber for manned tests of habitable space environment for astronauts at North American Aviation's space division, Downey, Calif., for the National Aeronautics and Space Administration's Manned Spacecraft Center.