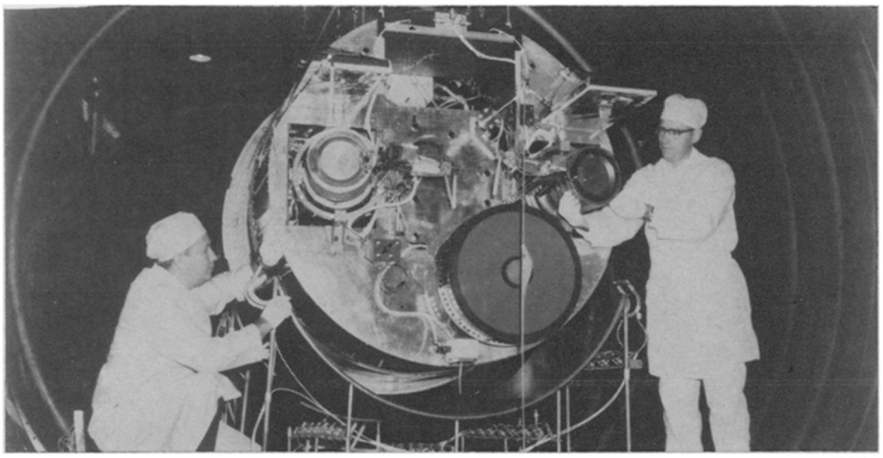

NASA

Its two ion-driven rocket engines showing, SERT 2 is prepared for launching.

ELECTRIC ROCKETS

Slow and steady gets its chance

For getting man to the moon, brute power has been the answer. This week, the National Aeronautics and Space Administration began the first orbital test of a radically different kind of rocket, the opposite of the ordinary run of rockets in both performance and philosophy.

The new extremist, called an electron-bombardment ion engine, is about 10 times as efficient as the most efficient chemical rockets.

But instead of concentrating all its effort in a mighty initial push, the ion engine just plods along, slowly and steadily, producing only a miniscule amount of thrust, but for long periods of time. Among the most important missions envisioned for the newcomer, in fact, are years-long probes to the outermost planets of the solar system.

To do this, the ion engines hoard their fuel as no chemical rocket could. In the orbital experiment that began this week, called SERT 2 for Space Electric Rocket Test, there are two rocket engines, each capable of producing six one-thousandths of a pound of thrust. What they lack in strength they make up in fuel economy: A single cubic centimeter of propellant is enough to drive either engine for 16 hours.

If a Saturn 5's first stage were to fire for that long—it burns out in about six minutes—each of its five engines would consume the contents of some 3,500 railroad tank cars. Of course the Saturn 5 engines are each churning out 1.5 million pounds of thrust, but it is all spent getting free of earth's gravity. The ion engine's job begins in space.

It produces its thrust by bombarding its propellant of vaporized mercury with a stream of electrons, creating a hot plasma of negative ions and free electrons. The ions are then accelerated in an electric field, and, as they leave the engine, they are neutralized with another electron beam to keep them from being attracted back to the spacecraft.

Despite the speed of the exhaust, however, it is still very rarefied and weak, so much so that the engine would not even operate amid the smothering resistance of the atmosphere.

SERT 2 was launched Feb. 3, but the first of the two ion engines was not turned on until this week. The mission plan is to operate the first engine for six months, then shut it off and turn on the second engine for about 100 days, with the plane of the probe's polar orbit keeping it in continuous sunlight for the whole time, a necessity for the solar-powered engines. Then, following a few months of intermittent sunlight due to a different orbit-sun angle, the second engine will be restarted for a six-month firing.

The only previous SERT test was an up-and-down flight in 1964 aboard a Scout rocket, designed only to find out whether the ion beam could indeed be neutralized in space. Although scientists at NASA's Lewis Research Center in Cleveland, where the engine was developed, were virtually certain that it would work, they couldn't test it on earth. In earth-bound vacuum chambers, electrons sputtered off the chamber walls by the exhaust made it impossible to measure the efficiency of the neutralizing stream.

SERT 2 is the only orbital flight planned for the program. Next, if it is successful, may come tests such as attitude control systems on operational satellites. One future possibility is an ion-powered mission to the asteroid belt between Mars and Jupiter, with the weak push permitting an extended study.

CANCER

Tumors in smoking dogs

To defend itself against charges that cigarette smoking causes lung cancer, the tobacco industry stresses the fact that the evidence is statistical, not biological.

To obtain biological evidence, Dr. Oscar Auerbach of the Veterans Administration Hospital in East Orange, N.J., taught healthy, young beagles to smoke. Twelve dogs that smoked seven nonfilter cigarettes a day for more than two years have died of lung tumors.

The tobacco industry does not accept this as any more valid than the statistical data. It contends that data from beagles cannot be extrapolated to man.

Dr. Auerbach, who pioneered with Dr. E. Cuyler Hammond of the American Cancer Society the statistical studies implicating cigarettes with cancer, reported his animal data to a meeting of the ACS directors last week. Eight beagles, used as controls, smoked nothing at all and developed no lung diseases. Eighty-six other animals were taught to smoke—taking smoke into their lungs through a tube in their throats—in a period of 56 days.

Thirty-eight of these dogs were put in a heavy-smoker group, consuming seven nonfilters daily. These animals will smoke for the duration of their lives and none will be sacrificed. Twelve of them have died; the others are still smoking. Dr. Hammond estimates that the amount of smoke consumed by these animals in two and a half years is equivalent to that of a man smoking two packs a day for 18 years.

The remaining 48 beagles were divided into three groups. Half were grouped as heavy nonfilter smokers, 12 followed a light schedule of filter cigarette smoking and 12 a light schedule of nonfilters. The last two groups were exposed to half the amount of tar and nicotine as the heavy smokers.

When 16 of that 48 had died, all were sacrificed and their lungs examined for signs of cancer or other disease. The results, Dr. Auerbach indicates, show that filter cigarettes are safer than nonfilters, but that the safety factor is relative. Filter cigarettes, he says, cannot objectively be called "safe."

Of the 16 that died, 12 died of lung diseases, including emphysema and bronchopneumonia. Altogether, 91.7 percent of the heavy nonfilter smokers showed evidence of serious lung deterioration, compared to only 5.7 percent of those on a light schedule of filters and 12.9 percent of those smoking only half as many nonfilters as the heavy smoking group.