SPACE

Solid Fuel Breakthrough

Basic research scientists have succeeded in refiring solid rocket fuels which should lead to solid boosters capable of restarting in space, Tove Neville reports.

➤ ROCKETS into outer space powered by solid fuels will be stopped and started in the future.

United States scientists have overcome one of the biggest problems facing future space travel by refiring solid rocket fuel for the first time.

This achievement of experimental research is a giant step toward the huge boosters needed to launch heavy space "hardware" for orbiting space stations and manned bases on the moon and planets.

Solid fuel rockets have looked to many scientists like the "ideal" future boosters, except for one important drawback, the inability to relight the fuel, and thus control how much thrust, or lifting power, would be applied and for how long.

Now scientists at the National Aeronautics and Space Administration's Lewis Research Center, Cleveland, have found a method for refiring the fuel. Dr. Walter T. Olson, chief of the chemistry and energy conversion division at Lewis, told SCIENCE SERVICE that the refiring was successful experimentally. However, much work has yet to be done before the method can be applied to space-borne rocket boosters.

The important breakthrough was made by injecting spontaneously reacting liquids, such as chlorine trifluoride, into the solid propellant from a vessel with a valve. The valve can admit liquid to the solid fuel when the refiring process is desired.

Dr. Olson said the liquid reacts with aluminum in the propellant and also with many of the solid fuel binders, such as polyurethane and polysulfide. Repeated "starts" of the fuels were made during tests in thin atmosphere and under low pressures in the Lewis 20-foot wind tunnel and in test chambers.

Research was also done in connection with the refiring method in the laboratory to study the details on how ignited fluids react with solids.

At the present time the powder of solid fuel rockets is ignited by a one-shot explosive. When the new refiring method becomes operational, a liquid that can be admitted to the fuel whenever the rocket is to be restarted will replace the explosive.

Another very difficult problem of solid fuels is putting out the fire to shut off the rocket once it is in space, and perhaps give men a chance to unload gear for a space platform or moon base before they restart the rocket to take them back to earth.

Work is also being done at Lewis on the shut-off which is accomplished by opening a vent in the rocket case so the pressure drops very rapidly. Sometimes the fuel appears to have stopped burning but starts up again because there are still traces of combustion left. The trick is to drop the pressure fast enough to make the fire go out entirely, Dr. Olson said.

He said the Lewis scientists are now studying how fast to drop the pressure for different kinds of propellants, among them polysulfide, polyurethane, and a mixture of nitrocellulose and nitroglycerin called double base.

The state of the art of solid rocket fuels has lagged behind that of liquids because solid fuel rockets have mainly been conceived as one-shot uncontrollable types whereas the liquid fuel rockets can be controlled. This has been the one great advantage of the liquid-type rocket and is probably the reason for the great use of liquid fuel for most space rockets.

Such space vehicles as the Redstone that carried the U.S. astronauts on their suborbital flights, the Atlas scheduled to orbit the first U.S. spaceman around the earth, and the Saturn, recently successfully tested and expected to send a space laboratory around the earth, use liquid propellants. Liquid rocket engines are also now planned for the Nova project vehicle that will take men to the moon. The liquid engine for the Nova, the F-1, has already been built and tested.

However, the liquid rockets have many drawbacks not found in the solids. The liquid engines are very complex, with countless tubes, valves and wiring that must be checked for malfunctioning just before launch. The procedure requires as much as 48 hours in some cases. The fuel has to be loaded into the engines at the last moment, and if the launch is postponed, the fuel is drained out again and the engines cleaned before a new launch is possible.

All this is expensive and time-consuming. The possibility for error and failure is also much greater the more complex the system, and the launching of liquid fuel rockets requires very large crews working many man-hours. An added burden is the handling of liquid fuels, such as the oxygen and hydrogen used for liquid rocket engines. These chemicals in liquid forms have to be handled, transported and stored at extremely low temperatures. Liquid hydrogen vaporizes if it is not kept at below minus 422 degrees Fahrenheit. The boiling point of liquid oxygen is minus 297 degrees Fahrenheit.

But once the liquid fuel is safely in the rocket and fired it is more efficient than solid fuel since it takes less liquid fuel than solid to lift the same weight.

Nevertheless, the advantages of solid rockets for large boosters are overwhelming. They are easier to fabricate, store, handle, transport (with the fuel already in the vehicle), and they cost much less. No fancy, complicated engine set-up is required. The fuel merely is built into a stack that either burns from the center outward or from one end to the other.

More sophisticated solid rockets in sections are now being planned.

Solid fuel rockets are especially of great military importance because they can be easily transported to areas where liquid fuel transport would be very tricky if not impossible. Some of the most important solid fuel rockets to date are: the Navy's Polaris launched from submarines, the NASA Scout sounding rocket used to launch ionospheric probes, the Air Force Minuteman and the Army's Pershing. The Air Force plans the development of a solid fuel Saturn rocket in the immediate future. This program is expected to cost $60 million or more.

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PSYCHOLOGY

Creative Thinking Found In Ninth Grade Students

➤ ABILITY TO THINK creatively can be spotted in high school freshmen as well as in young adults, Drs. J. P. Guilford, Philip R. Merrifield and Anna Cox of the University of Southern California reported to the National Academy of Sciences in Los Angeles.

The conclusion was based on test scores for several hundred boys and girls, including students of modern IQ as well as superior students. Essentially the same mental skills were found in all the ninth grade students as had been found previously in gifted adults, they reported.

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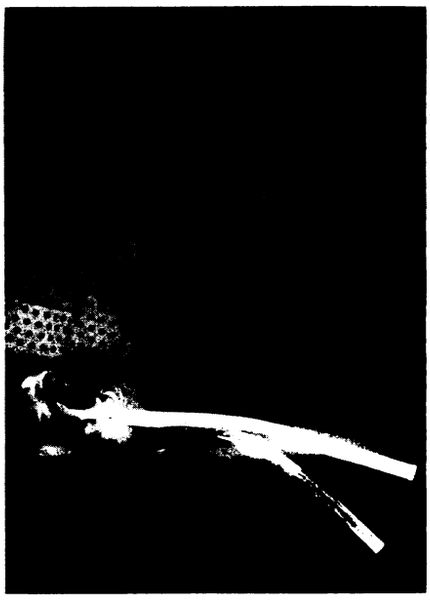

ULTRA-PURE QUARTZ—Heat-resistant fused quartz, made by General Electric Company, Cleveland, Ohio, is tested in a flame torch. The quartz, top tube, resists the heat considerably better than an imported product, lower tube. The new tube will be used in space sciences, electronics and lamp industries.