



Du Pont Company

BLASTED INTO SHAPE—The three-inch steel disc being examined above by a Du Pont Company engineer was made by blasting two types of steel into a single plate. The end result—stainless steel on top of carbon steel. The two were joined by powerful shock waves generated in a precisely controlled explosion.

can be more economically produced one at a time by high energy forming methods.

Explosives are used in the metal working field primarily in the areas of forming, hardening, cutting, cladding, wire-rope "swaging," and in a slightly different sense, riveting.

Explosive metal forming, just as electric spark metal forming, usually takes place underwater. A sheet of the metallic material is placed on top of a die with a vacuum between the underside of the metal and the die. Then, an explosive charge, suspended in the water above the metal, is detonated.

The tremendous shock waves generated by the explosion are transmitted through the water, pressing the metal into the shape of the die. If electricity is used in forming the metal, a spark is generated between two underwater electrodes to produce similar waves.

Sheet explosive, a high energy explosive that comes in a linoleum-like form is increasing the wear life of railroad manganese steel frogs and other trackwork castings. Pieces of sheet explosive are attached to the frog or other metallic equipment and detonated.

The explosion subjects the metal to high shocks that cause the molecular structure of the steel to readjust. This readjustment within the steel increases its hardness, sometimes by as much as 300%.

Sheet explosive is used to cut metallic materials into different shapes. Wire rope swaging involves the use of explosives to compress fittings onto wire rope.

Using the force of explosives to blow things together rather than into bits marks another milestone in the progress of man. Inventive genius has found another peaceful and creative use for destructive force.

• Science News Letter, 85:378 June 13, 1964

CHEMISTRY

Hydrogen Is Headache For Saturn Engineers

► LIQUID HYDROGEN has created many problems, and solved a few, for engineers working on Saturn rockets, one of which will boost the first Americans to the moon.

Liquid hydrogen, or LH₂, gives much greater thrust than conventional rocket fuels. In 1960, the National Aeronautics and Space Administration assigned the Rocketdyne Division of North American Aviation to develop a liquid hydrogen engine with 200,000 pounds of thrust. It was to be used singly or in clusters in the upper stages of Saturn boosters.

Problems began right away.

First, such an engine cannot contain oil or other conventional lubricants. LH₂ has a temperature of minus 423 degrees Fahrenheit, so any sort of oil would freeze.

LH₂ also leaks, said Paul Castenholz, chief of the project at Rocketdyne's installation, Canoga Park, Calif. Ordinary insulated joints will not hold it, so joints must be welded. Non-weldable joints were made with metal-to-metal flanges.

In addition, fuel tanks had to be insulated to keep the liquid in liquid form. Liquid oxygen, or LOX, forms a sort of "frost" from the moisture in the air around it. This frost is a good insulator.

LH₂, however, liquefies the surrounding air, which runs off the fuel tank like water, leaving no insulating coating. Special techniques were needed to keep the LH₂ cold. The solution was a sort of "thermos bottle," with an inner and outer tank, with a vacuum in between.

Unfortunately, the engine also had to be restartable in space with no outside power source.

For restarting in space, LH₂ is converted to hydrogen gas and compressed in a "bottle." When the bottle is full, a stream of gas is released, turning the engine motors and starting the fuel flow. A brief electrical impulse ignites the fuel.

Completed engines have now run almost 700 static tests of which over 500 were beyond the 500-second time required in flight.

Liquid hydrogen, however, sometimes solved its own problems. It proved to be its own best lubricant, for example. LH₂ is injected into bearings, providing perfect, almost frictionless motion. Furthermore, it saves considerable weight over oil.

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Do You Know?

About five percent of the U.S. population is allergic to *penicillin*.

The *fatty acids* in dairy products, eggs and all but the leanest of meats increase blood fat levels.

The "snooperscope" uses infrared light to illuminate young *salmon* while they are still submerged in gravel beds.

Giant *balloons* are expected to aid loggers in removing timber from now inaccessible forest areas.

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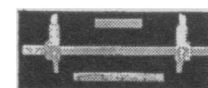
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