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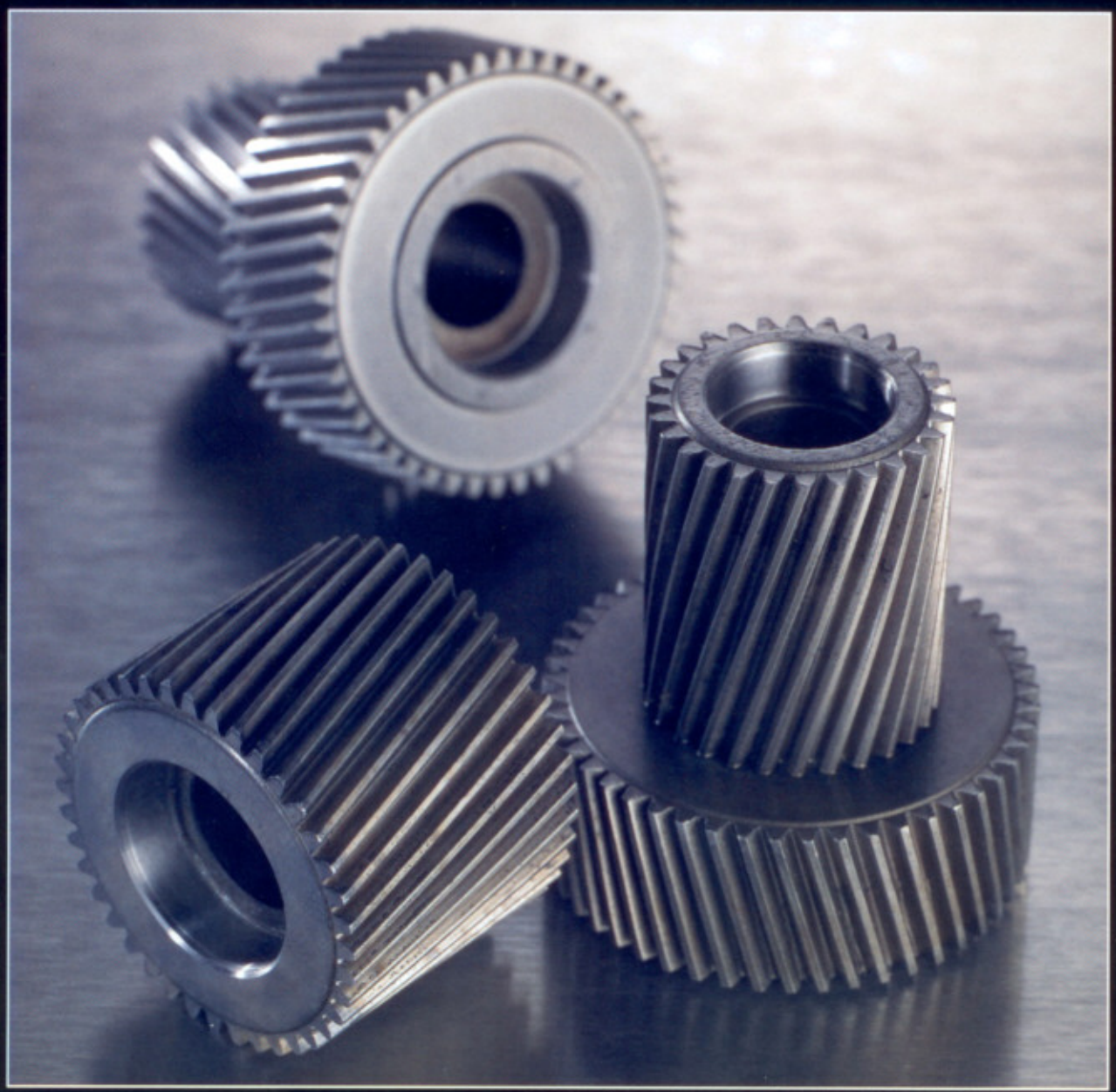

Recycling: War on waste in the weapons industry

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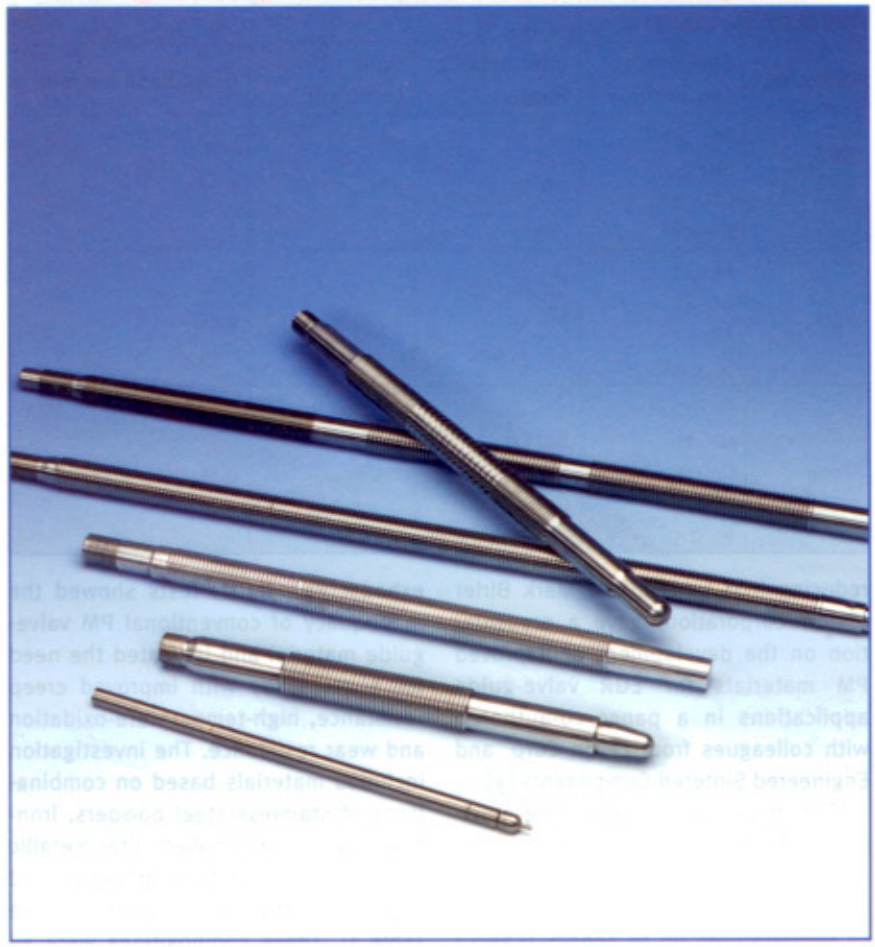
War on waste in hardmetal **weapons** production

Most manufacturing processes generate scrap, and even though powder metallurgy is notable for its low scrap production, these days scrap is a valuable commodity. A Tennessee company looked for economic ways to recycle hardmetal scrap and found a machine that filled the bill, says Bob Seeley...

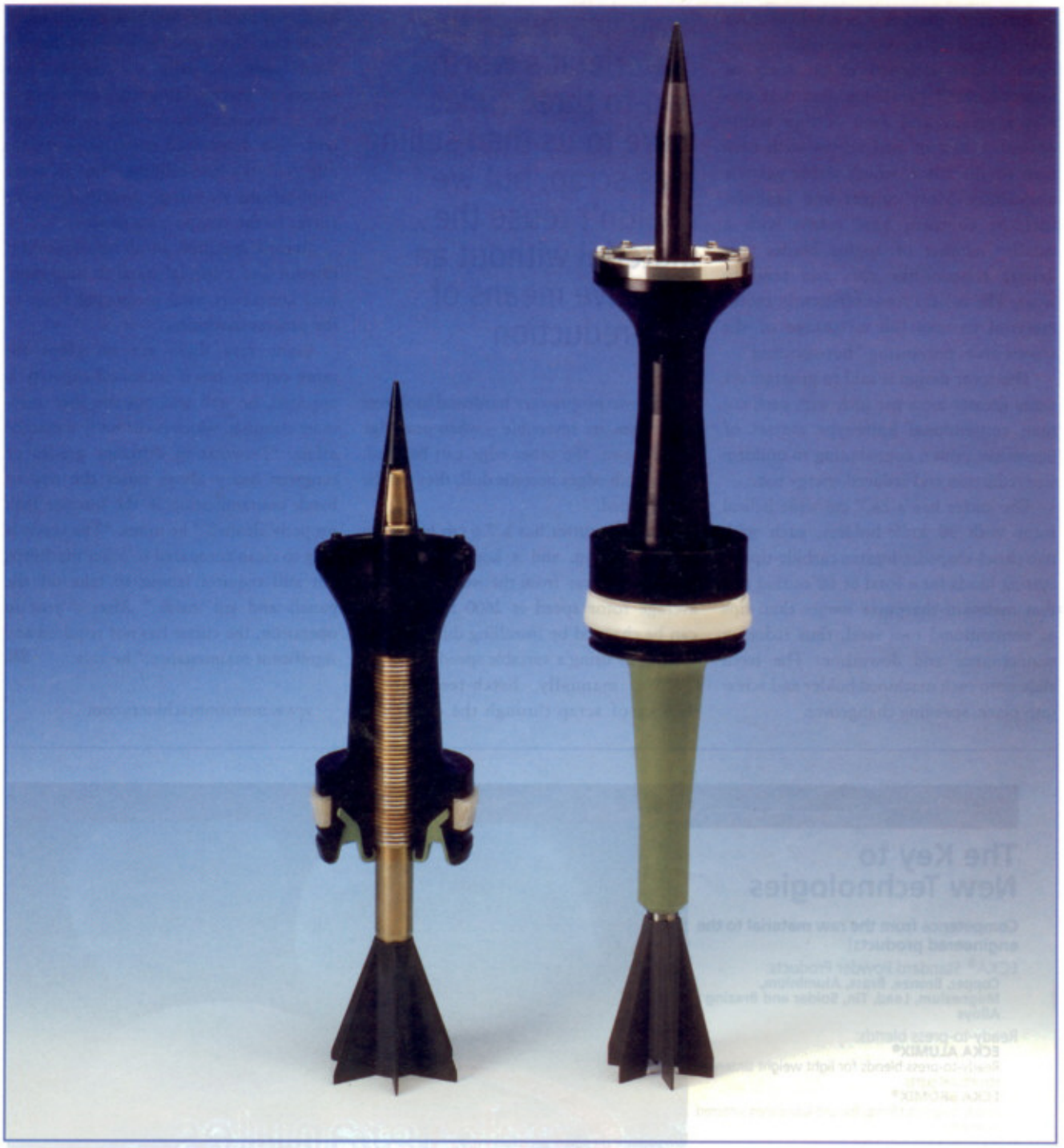
Aerojet Ordnance Tennessee, a wholly owned subsidiary of aerospace and defense contractor Aerojet General, fabricates parts from tungsten alloys and other refractory metals for defence-related products like ammunition, warheads and electronic shielding. The company also produces components for sporting goods and other end-uses, though defence accounts for about 80% of their business.

Tungsten alloys are one of the densest metal products manufactured. Reclaiming fabrication scrap was difficult and costly, prompting Aerojet to sell the scrap at significantly lower prices than it was worth as a recycled and reusable material.

The company uses tungsten heavy alloys for the properties they provide, including corrosion and radiation resistance, thermal and electrical conductivity, and machinability. The alloys are formulated with tungsten (85 to 98%) and alloying elements such as nickel, iron, or copper. Densities range from 17 to 18.6 gm/cc, about 2.5 times that of steel. One product the firm manufactures, as an example, is counterweights, which can be fabricated in smaller sizes than with other metals due to the density of the tungsten alloys.



Tungsten rods that lie at the core of anti-tank rounds.



Tank main gun armour-piercing ammunition.

Aerojet's products are not cast from molten metal; they are compacted from powder and sintered to full density, after which they are machined and finished. Scrap is generated as a result of compaction, sawing large blocks, and in other parts of the production process.

Aerojet experimented with techniques to reclaim tungsten alloy scrap. These included using a hammer mill and manually downsizing pieces.

None of the methods was efficient or produced consistently sized particles. A hammer mill's crushing, pulverising action isn't effective with a material of this density and generates dust. With manual reclaim, "labour costs were prohibitive and the results uneven," says Tim Brent, project engineer. Aerojet, consequently, wound up selling the scrap to dealers.

"If we can reuse the material it's worth two- to three-times more to us than selling it as scrap," says Brent. "But we couldn't reuse the material without an effective means of size-reduction."

After testing the performance of several size-reduction machines, comparing particle sizes, consistency and economy, Aerojet decided on an SCC 15 Screen Classifying Cutter from Munson Machinery. Aerojet's engineers were aware that the machine had a successful record in similar applications.

"The design is simple and stands up to the tungsten alloys," says Brent. The cutter is engineered to downsize hard materials like tungsten alloys into controlled particle sizes with few fines and no heat buildup.

Key to its efficiency is a helical rotor with dozens of tungsten carbide-tipped cutter heads attached to an array of interconnected parallelograms that creates a steady and even cutting action against a pair of bed knives with each turn of the rotor, which yields particle uniformity. Most cutters and granulators, by contrast, have rotors with a smaller number of angled blades that deliver scissors-like cuts and tend to wear. The helical rotor efficiently moves material to take full advantage of the screen area, preventing "hot-spotting".

The rotor design is said to generate six times greater force per inch with each cut than conventional knife-type cutters of equivalent power, contributing to uniform size reduction and reduced energy use.

The cutter has a 26.7 cm-wide helical rotor with 30 knife-holders, each with two chisel-shaped, tungsten carbide-tipped cutting heads for a total of 60 cutting tips that maintain sharpness longer than tips of conventional tool steel, thus reducing maintenance and downtime. The teeth slide onto each machined holder and screw into place, speeding changeover.

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The two proprietary hardened tool steel bed knives are reversible – when one edge wears down, the other edge can be used. When both edges become dull, they can be resharpened.

Aerojet's cutter has a 7.6 cm by 28 cm throat opening, and a hopper vent that draws dust away from the work area. The average rotor speed is 2600 rpm, which can be changed by installing different size sheaves or using a variable speed drive.

"We manually batch-feed about 45.4 kg of scrap through the cutter per hour, although the machine can do much more than that, and remove it by hand," Brent says. Actually the cutter "sees surges of several kilograms over a matter of seconds" as feeding is intermittent. The downsized material occasionally requires fine-milling, "but in some applications we can go directly from the cutter to the compaction process."

Aerojet specified an abrasion-resistant interior and a special stand to accommodate containers used in moving scrap to the process machines.

Brent says there are no plans for more cutters, but if increased capacity is required, he will add options that automate cleaning, which is currently a manual affair. "Downsizing different grades of tungsten heavy alloys raises the risk of batch contamination if the interior isn't properly cleaned," he notes. "The cutter is easy to clean compared to other machines, but still requires labour to take off the panels and get inside." After a year in operation, the cutter has not required any significant maintenance," he says.

www.munsonmachinery.com