‘Getting in Gear’with the Chain of Innovations

Frank Burke


Ring gear hobbing set-up.

At the dawn of the Industrial Revolution, so-called mechanics were tasked with devising the precise methods that would make mass production possible. The result was the first generation of machine tools, which in turn required improved tooling and production methods. The demand/response dialectic — known as the “chain of innovation” — remains operative in the present day and has in fact been especially energized by new technologies — even in traditional, mature industries.

In the gear making industry, the leading edge is represented by those shops involved in prototype development. One example is Delta Research Corporation of Livonia, Michigan, active since 1952 in the manufacture of prototype transmissions and gear components for the automotive, aerospace, defense, mining, and other industries. And with the acquisition of its sister company, Delta Gear, the company has combined prototyping with production capabilities and today produces over 1.5 million gears per year.

Tony Werschky, director of sales and partner at Delta Research (left), and Pete diMascio, director of Gear Technology.

According to Tony Werschky, director of sales and partner at Delta Research, “Our primary production includes parallel access gears, including spur and helical configurations up to 30 inches; most are actually less than 20 inches. We also make spiral bevel gears up to 20 inches. We now have three facilities totaling 132,000 sq. ft., and as we’ve grown, we’ve realized that in order to achieve the highest quality standards for our customers, we would have to embrace high-precision, automated methods and develop a workforce of highly trained professionals. The fact that we can offer the services and achieve the production we do indicates that it was the right formula.”

Because of the company’s longstanding relationships and experience in the automotive industry, Delta Research recently experienced a “chain of innovation” moment. As Pete DiMascio, director of gear technology at Delta Research, explains:

“The increased interest in both hybrid and all-electric cars has resulted in an urgent demand for a silent transmission. Transmissions have come a long way in terms of noise reduction, but the whole or partial elimination of the sounds produced by an internal combustion engine demand even quieter operation. This translates to higher precision in the gear design in order to reduce noise.

“Also, in an effort to conform to CAFE (mileage) standards set by the government, virtually every component is being reviewed in terms of weight and performance. As a result of the new requirements and technology that is available to the industry, we’re currently producing gears previously undreamed of in the automobile industry.”

The development process includes the processing of different grades of steel as they are tested for durability and wear. Steels include case hardened or carburized 5120, 4320, and 8620, as well as induction hardened and nitride 4140.

DiMascio comments, “When we deal with automotive prototypes, we have to be aware that we are not just manufacturing the prototype. We offer manufacturing feasibility to our customers, keeping in mind that these gears, shafts

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Ring gears before and after machining.

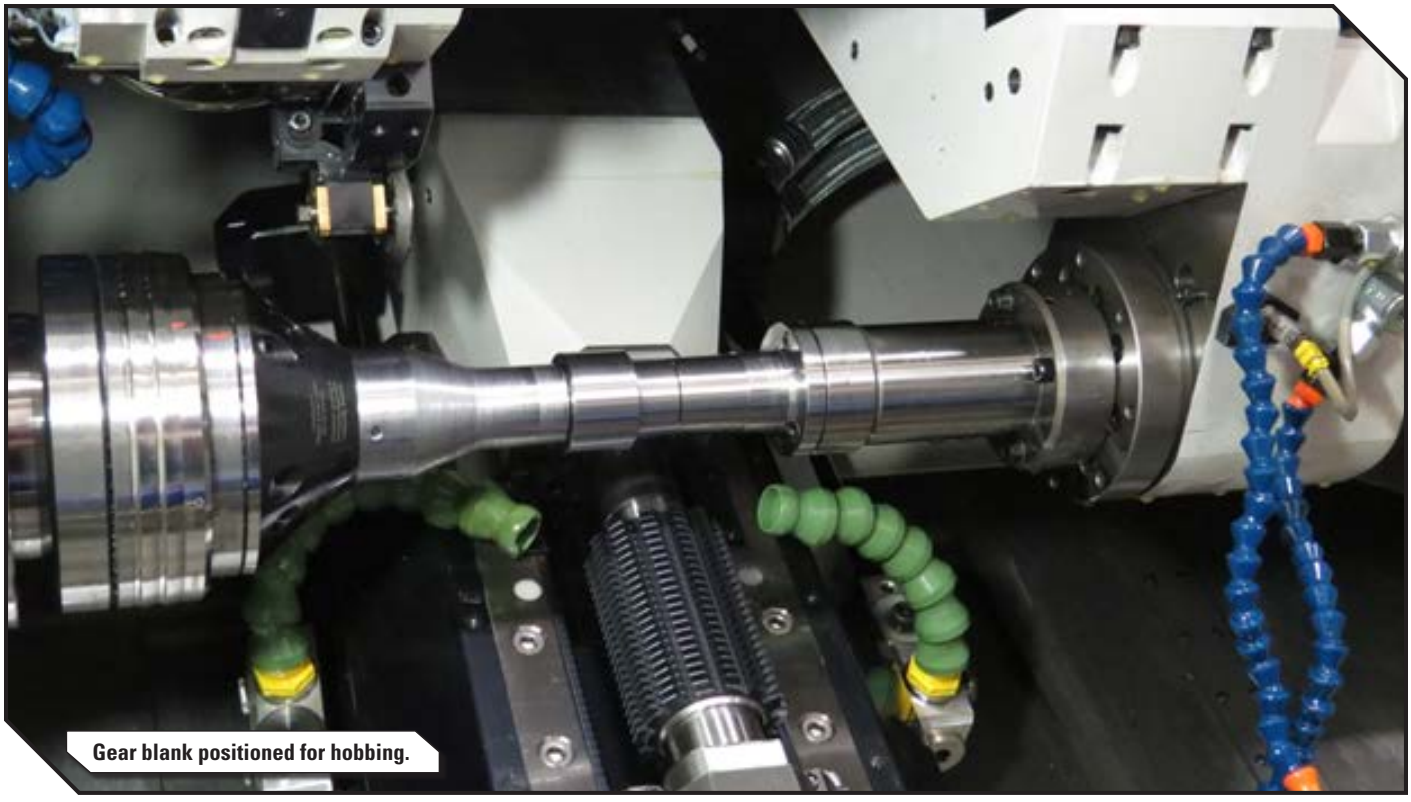
or assemblies will eventually be produced in high volume, once the optimum design is selected. Even though we typically produce only 20 to 50 to 100 pieces in prototype runs, our production experience has helped us and our customers develop the future manufacturing model.

Key to the process is precision workholding, and Delta has standardized on Hainbuch precision chucks and arbors in the gear making process. Werschky recalls, "When making larger volumes of prototype gears, we could no longer indicate every piece prior to finish machining. We needed precise yet flexible part-holding. Custom tooling required us to finish the part-holding diameters and faces to highly precise and consistent tolerances; this was not optimal for us. Using the Hainbuch expandable arbors allowed us to continually produce consistent, high-precision parts without having to indicate or overmachine the finished part-holding tolerances." DiMascio adds, "The Hainbuch chucks give us expansion capabilities up to 0.010 inch, depending on the diameter of the collet."

The Hainbuch chucks' Quick Change capabilities also offer significant advantages in that it is possible to change the collet size within minutes — without having to change the base chuck (which can take hours).

Typically, teeth are roughed out with lower-cost tooling but finished with high precision grinding up to, in some cases, .00004 inch. "Hard-finished teeth at that degree of precision haven't previously been used in automotive transmissions," Werschky says, "but the combination of hardened materials, precision, and fine surface finish not only reduces noise but results in longer gear life." The change to precision workholding has resulted in other improvements as well, DiMascio explains.

"We have developed a tooling library to optimize the Hainbuch advantage.



Gear blank positioned for hobbing.

These chucks work extremely well with robot and/or gantry load/unload systems, and have proven invaluable to our automated processes. Also, we've saved tens of thousands of dollars in tooling costs since we've equipped all of our gear making machines with Hainbuch chucks."

For Hainbuch's Larry McMillan, "Precision machining, especially in automated systems, begins with workholding, and the Hainbuch expanding arbor design offers several significant advantages. It expands to plus or minus 250 microns (.010 inch); it's available in different sizes, so it's both easy and economical for shops to standardize; and it eliminates additional support operations.

"If there is such a thing, I would consider Delta Research a 'gear boutique.' They're defining the solutions that will ultimately become standards for the automotive industry."

Werschky agrees. "Today, everyone is operating smarter. For test purposes, the automotive industry will ask us to do 100 samples — rather than 20 — and finish them at different stages — providing them with a library of samples in which to test." As Delta's DiMascio observes, "When changes have to be made, we can do it in real time. And the ability to meet that demand is what makes Delta Research an excellent partner for our customers — and the latest link in the chain of innovation."

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Hainbuch system showing collet prior to part loading.

Frank Burke has over 35 years of experience in the machine tool and allied industries. He started his career with Cincinnati Milacron and subsequently worked with White-Sundstrand Machine Tool Corp. Burke has twice presented to Canada's Advanced Technology Think Tank and has written extensively on technology and communications. He holds an MBA from The Wharton School of the University of Pennsylvania.