Welcome to **Revolutions**, *the column that brings you the latest, most up-to-date and easy-to-read information about the people and technology of the gear industry.* **Revolutions** *welcomes your submissions. Please send them to* **Gear Technology**, *P.O. Box 1426, Elk Grove Village, IL 60009, fax (847) 437-6618 or e-mail* **people@geartechnology.com**. *If you'd like more information about any of the articles that appear, please use Rapid Reader Response at* **www.geartechnology.com/rrr.htm**.

Edwin R. Fellows: Shaping the Gear Industry

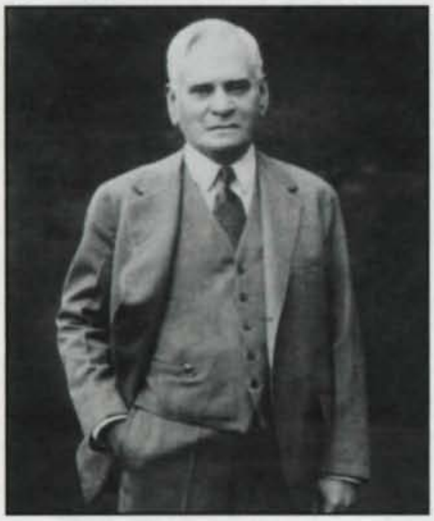
On July 13, 1896, a former window dresser received a $5,000 budget to start a company for making his far-reaching invention: the gear shaper machine.

The former window dresser was Edwin R. Fellows from Torrington, CT. The money was from subscribers (read: venture capitalists). And his invention was an idea he worked on while a draftsman at Jones & Lamson Machine Co. in Springfield, VT.

In 1916, the Fellows Gear Shaper Co. reached $1 million in machinery sales for the first time. The business that became Fellows Corp. was on its way. By then, Fellows was a director of his company.

In 1896, though, he was its 31-year-old manager, with a workforce of seven people. His first gear shaper machine was completed in 1897, though an experimental version had been built in 1896, at a machine shop in Fitchburg, MA.

Fellows' machine introduced a new type of gear-cutting tool. His shaper cutter was a hardened, ground gear with sharpened teeth.



Edwin R. Fellows: The former window dresser made good as the inventor of the gear shaper machine.

"At that time, no one else was making gear (shaper) cutters," says Don Whitney, a former manager of Fellows Corp.'s cutter-engineering department.

By 1905, Fellows' company was already having an impact on the automobile industry. That impact is reflected in *Precision Valley*, an account of the machine-tool industry that developed in the valley where Springfield is located.

The book lists automobile manufacturers that were Fellows customers in 1905. Those manufacturers included Buick Motor Co., Packard Motor Car Co., Olds Motor Works, Dodge Brothers, Cadillac Motor Car Co., and Pierce-Arrow Motor Car Co.

Before his company's start, though, Fellows got his start in Springfield with the help of a friend, James Hartness.

Hartness is remembered as a prominent Vermont industrialist and public figure. He is credited with 120 patents, ranging from the flat turret lathe to a safety razor. In 1900, he became president of Jones & Lamson. In 1921, he became Vermont's governor.

In 1889, though, Hartness was an employee at Jones & Lamson and was urging his Connecticut friend to join him. Fellows did so and became a Jones & Lamson employee in 1889.

The future industrialists knew each other through Fellows' mother.

Years earlier, Fellows' father had died while Fellows was in high school. Afterward, Fellows' mother took in boarders.

"Young Hartness was one of the boarders," Whitney says. "He and Edwin were good friends."

Whitney knows about Fellows and his company from work-related research and personal curiosity. For a time, Whitney taught a cutter design course at Fellows Corp., so he researched the company's history to create a preface for the booklet used in the course.

As for his personal curiosity, the 45-year employee of Fellows Corp. says: "I'm naturally interested in it because that was my life."

Fellows' invention received public recognition just a few years after his company's start.

In 1899, Fellows received the John Scott Award from the city of Philadelphia for his gear shaper machine and cutter. The award is given to men and women whose inventions contribute in outstanding ways to people's comfort, welfare and happiness. Other recipients of the award include Marie Curie, Thomas Edison, Jonas Salk and Orville and Wilbur Wright.

Fellows' machine made gears by simulating the meshing of two gears rotating around two parallel axes. A gear blank would be mounted on a vertical arbor. A complete gear, the cutter would then move up and down as it and the blank slowly revolved synchronously.

As Whitney explains, one cutter could produce spur and helical gears of any size, with any number of teeth—whether they were external or internal gears. L.T.C. Holt, though, notes a restriction in his book *A Short History of Machine Tools:* Fellows' cutter could make different-sized gears so long as their pitches were the same and the gears' teeth had the helix angle the cutter was made to create.

Whitney says that ability represented a significant advance in gear manufacturing.

Also, Fellows' gear shaper could make "shoulder gears," two different-sized gears on the same shaft with little clearance between them. That ability permitted more compact design of automobile transmissions.

In Holt's opinion, though, Fellows' cutter-grinding machine was more significant than his gear shaper machine. He explains that Fellows' precision grinding machine foreshadowed the grinding of hardened gears as a common step in production.

Fellows worked for his company for the rest of his life. He was president and director when he died May 21, 1945.

Fellows Corp. continued to serve gear manufacturers for another 57 years. It stopped operations Feb. 13, its parent company filing for bankruptcy.

On May 23, BF Acquisition won its bid for Fellows Corp. BF Acquisition is an affiliate of Park Corp., an Ohio-based company.

As reported in the *Rutland Herald* of Rutland, VT, BF Acquisition bid $3.72 million for the company.

BF Acquisition's purchase was expected to receive final approval May 28 from U.S. Bankruptcy Court in Delaware. Closing on the sale was expected to occur May 31.

A Two-Story Gear Unit

BHS-Cincinnati Getriebetechnik GmbH of Sonthofen, Germany, recently delivered what it says is the world's largest integral gear unit at more than 5 meters wide, more than 4.5 meters tall and weighing more than 42 tons. The gear unit was sold to MAN Turbomaschinen AG, GHH Borsig, of Berlin, a German compressor manufacturer.

MAN Turbomaschinen's customer, a Chinese chemical plant, plans to use this gear unit for manufacturing purefied terephthalic acid (PTA), a material used in polyester fiber production.

What's unique about these large integral gear units is that the compressor is not mounted in line with the gear drive but is directly mounted to the gear casing, says BHS engineering sales manager Stefan Burkart. With this arrangement, the efficiency rate can be significantly improved and the space requirement significantly reduced versus traditional stand-alone units.

Other companies make this kind of device, but this one is larger than most. However, similar sized integral gear units are sold by Flender Corp. of Bocholt, Germany, and SMS Demag AG of Düsseldorf, Germany.

The primary advantage of the integral gear unit is the compact installation it provides through the elimination of the coupling along with the capability of mounting the compressor housing directly to the gearbox, says Patrick Potter, sales engineer at BHS-Cincinnati. Even for single-pinion units, this is a significant advantage because the compressor housing can be overhung from the skid, which allows much more flexibility in piping arrangements for the compressor's process gas.

For multiple-pinion units, the ability to mount the compressor casings directly to the gearbox is a technical and cost advantage because multiple stages of

Standing tall at 4.5 meters and weighing in at 42 tons, this integral gear unit from BHS-Cincinnati Getriebetechnik GmbH of Sonthofen, Germany, is the result of work by a team of engineers and was sold to a Chinese chemical plant.

compression can all be handled by one gearbox, instead of requiring several separate stand-alone units, Potter says.

The space-efficiency of the integral gear unit is accompanied by operating efficiency—thrust collars eliminate the need for high speed thrust bearings, and power losses are typically lower than stand-alone units. Also, since the journal bearings for the compressor wheels are eliminated (the impellers are mounted on the pinions and the compressor uses gear unit bearings), a further reduction in system power loss is realized.

The freedom in selecting different pinion speeds allows an optimization of the aerodynamic efficiency in each stage of compression, Potter says. This explains why the overall power loss of an integral geared compressor is typically much lower than stand-alone units.

With the ability to drive up to 10 flange-mounted impellers, the units are equipped with thrust collars to eliminate the high speed thrust bearings. The collars transfer the thrust to the bull gear, where the axial load is taken by a low speed thrust bearing. The compressors' impellers are seated on extended pinion shafts, and the spiral housings are flange mounted onto the gear housing.

Featuring single-helical gearing with pinions of thrust collar design, the gearbox design holds upper and lower housing components for two- to four-stage applications. For five- to eight-stage designs, customers can use upper, middle and lower housing components.

To have nine- and 10-stage compressor applications, the customer has to install a fifth pinion below the bull gear. This pinion also can drive the bull gear and gearbox for turbine applications.

Regardless of the end use, Europeans are buying the integral gear units en masse. Since February, 50 units have been sold by BHS-Cincinnati, which is manufacturing them at a rate of about 100 units a year. A full 90 percent of these machines are sold in Europe for 100,000 to 1 million euros, or about $92,000 to $918,000 apiece. The rest of the sales are split between companies in America and Japan.

Tell Us What You Think . . .
Visit *www.geartechnology.com* to
- **Rate this column**
- **Request more information**
- **Contact the companies mentioned**
- **Make a suggestion**

Or call (847) 437-6604 to talk to one of our editors!