The Painful Birth of the DC Electric Motor

Defined in rudimentary terms, an electric motor is a device that uses electricity to create mechanical force. But in 1834, when our story takes place, most people would have trouble understanding the ramifications.

That was the year that one of the earliest DC electric motors was invented—by a blacksmith. It's true. Thomas Davenport (1802–1851), a Vermont smithy, constructed the first American DC electric motor. He went on to produce literally hundreds of motors.

One of a dozen siblings—his father died when he was 10—at age 14 Davenport began serving a seven-year indentureship for a local blacksmith. His indentureship completed, in 1823 Davenport settled in Brandon, Vt. and opened his own blacksmith shop.

The genesis of Davenport's curiosity in electricity and magnetics was news that a nearby ironworks was using a new method for separating crushed ore. Developed by Joseph Henry, it used magnetized spikes secured to a rotating, wooden drum that attracted the purest of the iron content from the crushed ore. As it happens, this was quite timely in that the expansion of the railroads was spiking the need and demand for quality iron.

His interest piqued by the news from the ironworks, the uneducated Davenport read everything he could find on electricity and magnetics. Lacking money, Davenport asked his brother, a drummer, for help. They proceeded with a fire sale of sorts in that they unloaded most of the brother's wares, conducted some further horse trading, and secured enough money to buy one of the electromagnets.

Back in his shop, Davenport eagerly deconstructed the magnet as his wife, Emily, recorded each step. He then started his own experiments, building two magnets of his own design. One problem: insulated wire was required, but there wasn't any. Problem solved—Emily cut up her silk wedding dress into strips—*you just can't make this stuff up*—to provide the insulation required for maximum windings.

The electricity source used was what was known as a "three-cell Grove battery."

Davenport mounted one magnet on a wheel; the other was fixed to a stationary frame. The two magnets powered the rotor to turn one-half revolution. He then discovered that by reversing the wires to one of the magnets, the rotor would rotate another half-turn. Next, he devised what is now commonly known as a brush and commutator. Wires from the frame supplied current to a segmented conductor, thus supplying current to the rotor-mounted electromagnet. The result was reversal of the polarity of the rotor-mounted magnet—twice-per-rotation—resulting in non-stop operation.

The motor was capable of powering equipment in Davenport's shop, but he was looking beyond horseshoes. He sought to find a power source for railroads that could replace the steam locomotive, which at that time suffered frequent, deadly boiler explosions.

Davenport's solution: an electric locomotive. He even demonstrated it with a small-gage model train car on a short section of track, thus anticipating—knowingly or not—the electrification of passenger transport; e.g., streetcars. The "train" operated on a circular track with power supplied by a battery fixed to the locomotive and using the rails as conductors to transmit the electricity. Encouraged, Davenport traveled to Washington to obtain a patent. His application was rejected, due largely to ignorance of electric equipment (evidenced by the fact that there were no existing patents for electrical machinery of any type).

But the scientific community and the media responded—with enthusiasm. Benjamin Silliman, founder of *Silliman's Journal of Science*, wrote that "A power of great but unknown energy had unexpectedly been placed in mankind's hands." The *New York Herald* reported it with practically transcendental fervor: "The occult and mysterious principle of magnetism is being displayed in all of its magnificence and energy as Mr. Davenport runs his wheel."

Encouraged anew, Davenport returned to the patent office, armed this time with testimonials and—most importantly—a working model. Alas, the model was destroyed by fire before examination. He built yet another. Finally, in 1837 the first patent on any "electric machine" was issued to Davenport for his electric motor.

The motor was a technological success—and a dismal commercial failure. Just like the folks at the patent office, there was then a dearth of knowledge of how, for example, to predict energy strength in a chemical battery. But most of all, battery-powered motors could not begin to compete with steam engines. Funds were promised him, which were unfulfilled, so Davenport retreated to Vermont with hopes of writing a book on his work and vision for his electric motor. He died broken—financially and in spirit—in 1851 at the age of 49, his book never completed.

On a happier note, there is a patent office model of Davenport's motor in The Smithsonian Institution. (*Sources: "The Inventions of Thomas Davenport," by Franklin L. Pope—Transactions of the American Institute of Electrical Engineers, Vol. 8, 1891; edisontechcenter.org; "The Blacksmith's Motor," by Dr. Frank Wicks*— Mechanical Engineering *magazine, July 1999.*)