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mechanical engineering

www.memagazine.org

Vol. 130/No. 3 March 2008

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Improving the Wheelchair

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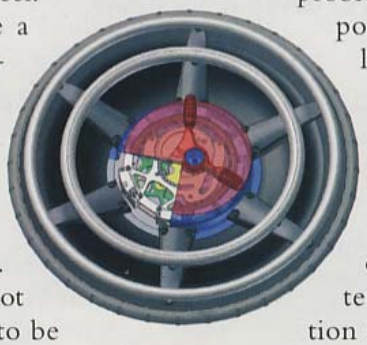
Improving the Wheelchair

The idea behind MagicWheels seems obvious: Build a mechanically powered wheelchair with gears so it takes less muscle power to roll up a ramp, come down a hill, or navigate uneven terrain. Yet it took Seattle inventor and ASME member Steve Meginniss 10 years to bring the concept to market.

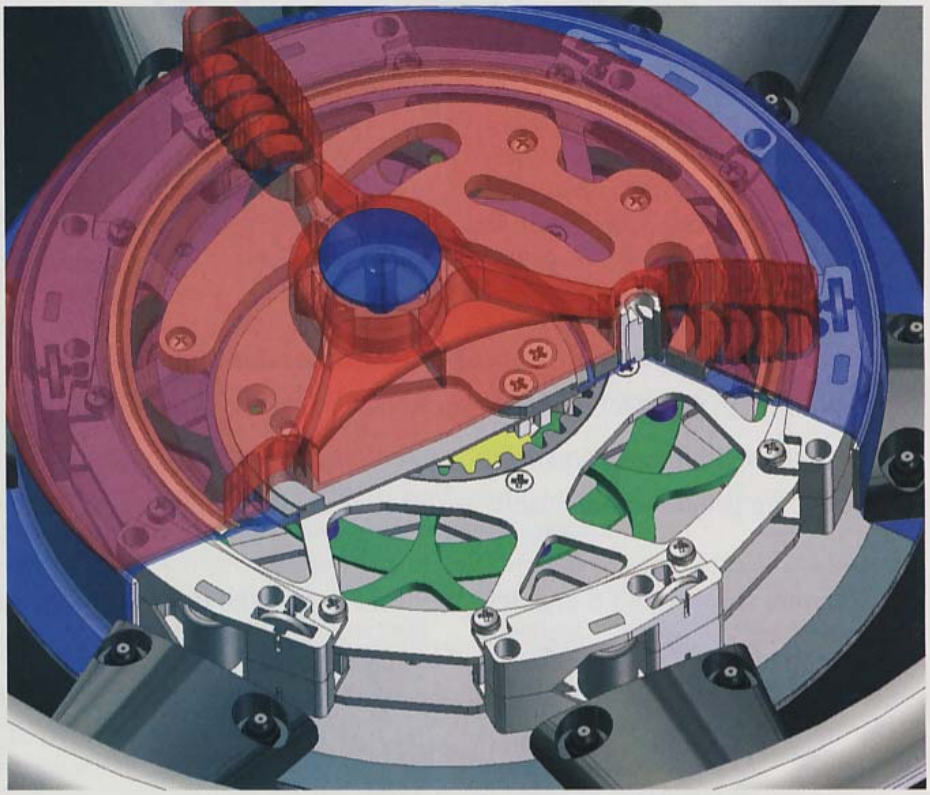
Meginniss, who invented the induction-charged, high-speed Sonicare toothbrush, was looking for a new project to work on in his basement. He learned about the wheelchair from the University of Washington technology transfer office. It took a decade and a surprising number of innovations before the company he founded, Magic Wheels Inc., could sell it.

Gearing a wheelchair is not as easy as it sounds. At first, Meginniss thought he might be able to take advantage of the two-speed bicycle hub gears that are popular in Europe. These simple hub gears are planetary mechanisms that start with a sun gear in the center. Two planetary gears circle around it, while their outside edges connect to a ring gear that imparts motion to the wheel.



It might sound like a great way to build a two-gear wheelchair, but it's not. Shifting hub gears involves pedaling backward and then forward, which creates a noticeable backlash. On wheelchairs, that's not acceptable. "We have to be able to drive forward and backward with minimal backlash between them," said Meginniss.

Even more important, though, a wheelchair must hold its position when moving up a hill. Even gentle hills—and ramps to buildings and cars—present challenges to people wheeling a chair. If they get tired or need to reposition their hands, they don't want to slip backward.



The world's first geared wheelchair uses a hypocycloidal drive that switches gears with a light nudge of the hand and holds its position on a hill or ramp without rolling backward.

Meginniss solved the hill holding problem by designing a hypocycloidal drive, which looks like a planetary gear without the sun. In low gear, it creates a huge eccentric load that locks the wheel into place so it will only move forward. His team also devised a friction system that, because of its size, needs to provide 10 to 15 times the 1,000 pounds per square inch of friction found on a car's brakes, but that releases easily enough so the wheelchair can move forward. "The friction system has to be more robust than one used on an earth-moving machine and weigh practically nothing," noted Meginniss.

Two other technologies make MagicWheels work. One is the shift. Not only does it have to move with a touch for people with limited arm mobility, but it must be compact. Meginniss says it is the first transmission that works in the plane of the wheel rather than back and forth along the hub. The second technology is the unit's aircraft-grade carbon fiber-reinforced wheels. They are exceptionally strong, yet thin enough to contain the entire gear mechanism in a space no deeper than that taken up by spoked wheels.

The result is a wheelchair that weighs about 10 pounds more than conventional mechanical systems, yet is much easier for active people to use day in and day out. Many of them prefer it to electrical systems because it keeps their working muscles strong and healthy, and they can retrofit it onto existing wheelchairs. Meginniss said the units retail for $4,995, but often cost less through insurance or government medical programs.

MAGIC WHEELS INC.

This section was edited by Associate Editor Alan S. Brown.