# the NuVinci code

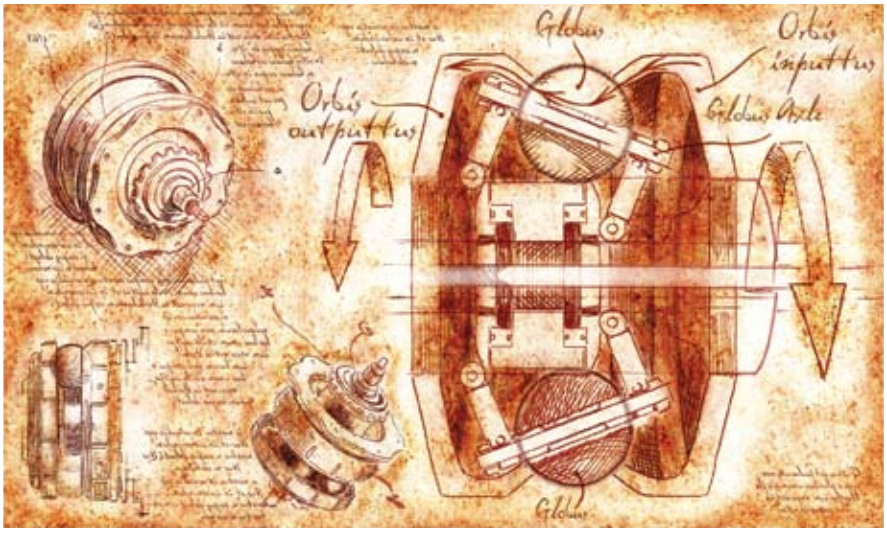
## At last, a tranny with some balls

■ illustration **glenn lumsden** ■ photograph **lionel deluy**

**MY INNER** Rube Goldberg (all good enginerds have one) has been fascinated by continuously variable transmissions since the DAF Daffodil Variomatic rubber-belt tranny. But because the car-buying public couldn't accept the way they were designed to work (it's not slipping, you dolt, the engine's supposed to zing to the power peak when you floor the gas pedal!), all CVTs in production today sacrifice some efficiency to mimic a "normal" automatic's acceleration sound. Now that six, seven, or eight-speed automatics are becoming commonplace, the CVT's torque limitations, bulky packaging, and costly manufacture caused me to give up on them.

But then I test-drove a completely new type of CVT, and the fascination was rekindled. These things are always tricky to describe, so, like-minded Rube-wannabes, read on (click motortrend.com for links to a video animation); everyone else has my blessing to jump one paragraph down. The continuously variable planetary transmission works like this: A set of balls (the planets) are arranged around a cylinder (the sun) and clamped between two dishlike discs with a C-shaped cross-section (the rings). When the balls spin on an axis parallel to the main power flow, the input and output dishes spin at the same speed (1:1 ratio). Tilting the ball axes one way or the other alters the ratio from underdrive to overdrive.

It's called NuVinci, in a nod to Leonardo, who sketched a CVT 500 years ago, and it's a traction-drive transmission. That means it uses friction to transmit torque between smooth, gearless surfaces, much like Nissan's disc-and-torus "Xtroid" CVT. If you haven't heard of it, that's because it doesn't work in countries like ours where temperatures can drop to -40° F. But Fallbrook Technologies and Valvoline have managed to solve this thorny problem with a design that inherently requires less clamping force, and with a new Nuvaritorc transmission fluid that momentarily behaves like a solid under high (100,000-400,000 psi) contact pressures to transmit torque, then returns to its liquid lubricating duties—even at low temperatures.



NuVinci's claimed advantages are many. Relative to other CVTs, it can transmit more torque, it's quieter and more durable, and its straight-through torque flow allows it to package in the same envelope as today's conventional automatics. And torque capacity can be adjusted across model variants by adding or subtracting balls, without increasing the overall size. Manufacturing costs are said to undercut other CVTs because there's less precision-machining involved and because none of the bearings has to withstand high speeds and high loads. Lower clamping forces improve overall efficiency, too.

Of course, there's nothing about the NuVinci's design that would keep motorists from making the same "slippage" complaints, so what's the point? Well, suppose the NuVinci wasn't connected to your shift lever, but to your accessory drive. Instead of making an alternator or A/C compressor sized to work at idle and hardened to withstand 7000 rpm, you could optimize it to run more efficiently within a narrower speed range controlled by a tiny NuVinci.

The company is starting small. My NuVinci test drive wasn't in a car, but on what'll be the world's first CVT-equipped bicycle to go on sale later this year from Ellsworth International. It's simply spectacular. You can shift smoothly while standing on the pedals without fear of a derailleur failure, and you also can shift from high to low range at a complete stop.

The CVT may yet play a roll in saving the planet, it just may do so in bikes, heavy trucks, and even huge wind-power generators before drivers learn to love it. My inner Rube is cool with that. ■

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