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# NuVinci's Gearless Gearbox

Could this be the one?

R. Cunningham



**Not a pipe dream:** The NuVinci CVT hub has been on the streets in testing for a number of years and has proved to be reliable. Fallbrook Technologies expects the first mass-produced units to arrive from its Chicago-based manufacture this fall. The NuVinci twist-shifter moves from low to high gear in one fourth of a turn.

**L**eonardo DaVinci designed the first variable-speed gearbox 500 years before Donald Miller seized upon the concept. Miller, an avid cyclist, was searching for the mechanical version of the Holy Grail—a multi-speed gearbox that could match the efficiency of a roller chain and a bunch of sprockets. Miller's solution comes closer than anyone has so far, and although Miller's transmission looks nothing like the Italian inventor's design, he and his associates at Fallbrook Technologies paid him homage by naming the invention the NuVinci CVT.

*"Oh no, not another variable-speed transmission that buzzes, whirrs and clacks its way through the gears like a 1970s adding machine. Hey, even Honda couldn't make their variable gearbox competitive."*

## NUVINCI CVT: THE NO-GEAR GEARBOX

CVT stands for Continuously Variable Transmission—a concept which is certainly not new in the halls of cycling. In just one decade, we have seen expanding chainrings, bottom brackets with cam-driven clutches, and hubs with ratcheting levers that follow bicircular rollers, but none leapt the three hurdles that a viable bicycle transmission must clear before it can even dream

of success: it must be lightweight, it must come very close to the efficiency of a chain drive, and it must be affordable. Even the present crop of multi-g geared hub transmissions cannot make it over all three obstacles. The NuVinci design, however, has the potential to be the first—and without a single internal gear or sprocket.

## HOW IT WORKS

Inside the NuVinci rear hub, there are five steel balls squeezed between two cupped steel discs. Each ball rotates on a shaft, and when the shafts are angled, the balls drive the steel discs at different speeds. That's it. The rear sprocket drives the "input disc" and balls drive the "output disc" attached to the hub. The magic of the NuVinci CVT is that it is, in essence, a giant ball bearing, and thus produces extremely little friction.

*"Wait a second, buster! How can five polished steel balls running on a polished steel ring develop enough traction to keep from slipping or skidding when a world class sprinter mashes down on the pedals? Isn't that why gear and sprocket teeth were invented—to handle high-torque loads?"*

## THE BIG SECRET

There is a secret stuff called "traction fluid" that rarely finds its way into the news media, but has been around for a good while. Traction fluid is like a synthetic lubricant that momentarily turns into a solid substance when it is put under great pressure. The cupped discs and balls are squeezed together with a preloaded spring and the contact points are small, so the traction fluid prevents slipping as well as a toothed gear could where the balls and discs meet. As the balls advance, the pressure is released and the traction fluid instantly returns to a liquid state. Valvoline partnered with Fallbrook Technologies to produce the stuff, and its technical name is: "elastohydrodynamic lubricant."

## HOW NUVINCI SHIFTS

There is certainly no secret when it comes to shifting the NuVinci hub. There's a handlebar-mounted, two-cable twist shifter. The cables move a "carriage" that rides under the balls inside the hub. As the carriage slides from one side of the hub to the other, it tilts the axis of all five balls simultaneously. There is very little force required to slide the carriage and rotate the balls, so shifts can be made while moving or standing still—anywhere between its lowest and highest range.

Shifting feels seamless. There is simply no sense of indexing or gear lash as the CVT slides smoothly to your chosen ratio with a twist of the wrist. The NuVinci can handle a 3.5:1 ratio, which is what most geared hubs or chain-driven systems can muster, and it doesn't require a rear or a front derailleur—just a chain and two sprockets.

"Yeah, but show me a hub transmission and I'll show you a boat anchor-in-the-making. Mountain bikers aren't going to lace a four-pound gearbox into their rear wheel no matter how well it shifts."

## NO MOUNTAIN BIKES—YET

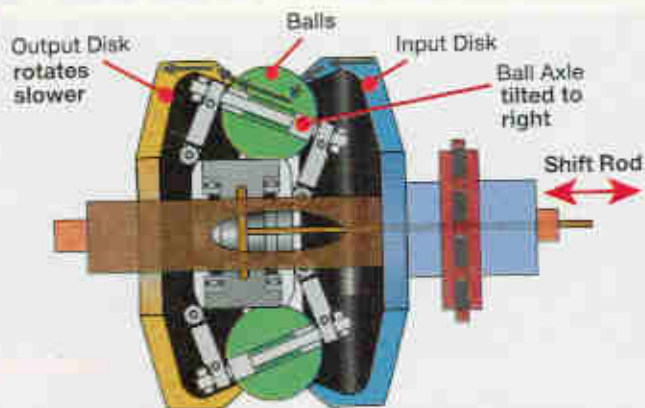
NuVinci's VP of Sales and Business Development Alan Nordin is careful to point out that Fallbrook Technologies wants to prove themselves in the bicycle industry by successfully launching the NuVinci CVT hub in the recreational and urban segment of the market first. This is where hub transmissions are already established and have the largest potential for sales. The NuVinci CVT is very competitive in weight with geared hubs, so it is a perfect fit.

NuVinci has already partnered with Ellsworth Cycles, who will be launching a line of citybikes and cruisers at this year's Interbike Exposition. Simply mentioning "Ellsworth" is a guarantee that NuVinci will find its way to a mountain bike. Presently, however, NuVinci CVT hubs are too heavy for performance cyclists. Fallbrook CEO Bill Klehm freely admits that it will require more development and testing before NuVinci will be poised to go after the derailleur-based mountain bike transmission, but he is confident that moment will arrive in the very near future.

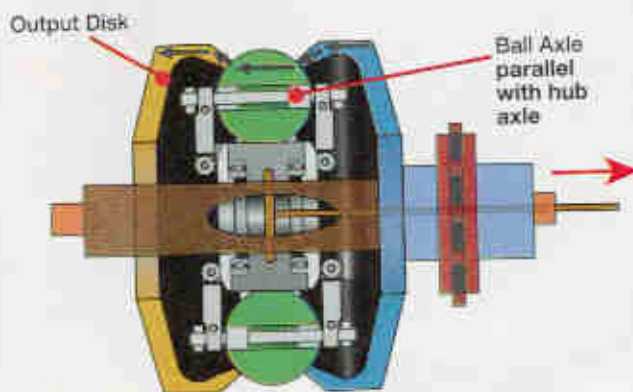
Who else is on board? Al Nordin's lips were sealed about exactly which big brands were signed on with NuVinci CVTs, but he did say that they had partnered with some heavy players in this country and in Europe.

## WHAT DO WE THINK?

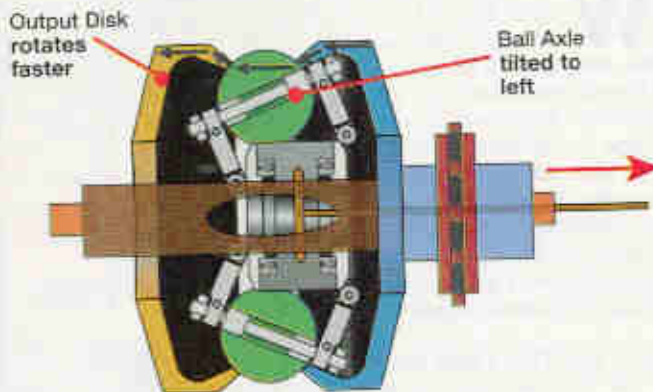
So far, NuVinci is a winner. The transmission contains no highly technical components, and it has less than fifty



**Low gear:** The right "input ring" drives the balls near their largest diameter; the balls then drive the left-side "output ring" from their smallest diameter.



**One-to-one:** With the balls un-tilted, the input and output rings rotate at the same speed because the rings contact the balls at the same distance from their axis.



**High gear:** The balls are tilted to the left now, so the right input ring drives the balls from their smallest diameter. This turns the balls at a higher speed. The output ring is driven from the ball's largest diameter, which further multiplies the hub's rotation.

parts. The drive and shifting system is so simple that it should prove to be reliable in an affordable, mass-produced situation. The balls and discs are highly loaded, so finding a lightweight method to construct these critical parts will be the key to success in the high-performance mountain bike world. All this can be done, however, and the fact that Shimano and SRAM have pushed the price of a pro-level derailleur transmission close to the thousand dollar mark insures that the NuVinci CVT will have a seat at the table. □