

CHRISTINI AWD

Are you ready to make your front wheel do half the work?

Until January of this year, two-wheel drive, or All Wheel Drive (AWD), motorcycles have been the darling of the mad scientist, the project of mechanical engineers with way too much time on their hands. There were people working on the concept, but until David Fretigne entered the Dakar Rally on a Yamaha AWD there were very few people taking the concept seriously. That is, until the OLN Network aired a tape of Dakar riders rounding a slippery but insignificant turn on a short mud-clogged stage on day two.

Many of the bike competitors rounded the turn and fell down, or got stuck. But Fretigne came around the turn all right, started losing the front end like nearly everyone else, but then his bike did something totally wrong. It seemed to grab hold and zip right out of the muddy corner, just like the hand of God just reached down and scooted the Frenchman on his way. That day was the first day I'd remembered to turn on the TV, the first time I had caught OLN's broadcast before it was only cars and trucks. I had just sat down cold, having no idea even who was riding what in the event. I saw Fretigne claw around that turn, and I spit popcorn halfway across the room. I swear, the hair stood up on the back of my neck. "Did you see that?" I yelled to the cat, "That guy should have fallen down! He WAS falling down! What the hell is going on here?"

I stopped raging at the poor animal long enough to hear that Fretigne was riding a Yamaha WR450 with the experimental/conceptual/prototype/whatever Ohlins hydraulic AWD system installed. What looked weird about the tape clip is that every one of us experienced riders could see all the motions of a guy who



Steve Christini and David Boyer of Christini Technologies pose with the AWD CRF450.

was about to fall down in the mud, and then the front wheel of his bike pulled him right out of the predicament. It was something no one had ever seen on TV or anywhere before, so I guess we can all be excused for being rattled by it. As soon as I recovered from the shock I was on the phone to Yamaha—no lie—trying to set up a test ride on the bike.

"C'mon Bossman," said Terry Beal, my man in Cypress, California, home to Yamaha USA, "Give the poor guy a chance to get out of Africa before you take his bike from him!"

He had a point. So I let David Fretigne finish the Dakar Rally, and he did win the stages on days

two and three, the muddiest of the event, and finally finished sixth overall bike. But the wheels of commerce turn slowly sometimes, and as of this writing I still haven't slung a leg over Fretigne's bike. Yamaha says they're less than enthusiastic about releasing the bike to the American press because they have no plan to market the bike in the U.S.; to which I say, "Oh, you will; you'll have to." We will ride that bike some day, but it just hasn't happened yet.

Turns out, we were not the only ones interested. Immediately after Dakar, anyone who wasn't experimenting with AWD immediately got on the bandwagon. AWD is probably going to be the Next Big Thing on dirt bikes, and the concept actually has so much potential for road bikes that AWD might be a common feature on all brands of motorcycles within ten years. But, we're getting ahead of ourselves with that statement.

In the mean time, on a rainy day of May this year I received a call from Jeff Botsford, owner of Moto Jockey in New Castle, Delaware. He had been involved in testing of an AWD bike, and wanted to introduce me to Steve Christini of Christini Technologies in Philadelphia. I actually had heard of Christini before, and I knew their company was marketing a two-wheel drive mountain bike. What I didn't

know was they had built a prototype AWD motorcycle, using their same mountain bike technology on a Honda CRF450R, and would I like to try it out? Well, yeah...

We met on an afternoon when black clouds were rolling in from the west, and got dressed and out on the bike just as thunderstorms attempted to drown us. And actually, that was about the perfect conditions to be testing such a bike. We were on flat land, so we didn't have serious hills to test the front grip, but a



A small sprocket on top of the countershaft sprocket transfers power to the steering head, where it is turned and pointed at the front wheel.



Power is transmitted by twin telescoping shafts down the front of the forks. The stock axle carriers on the lower forks were replaced with a pair of drive mechanisms to power the stock Honda hub.



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one of Steve Christini's shots of the bike on dry sand, something we didn't have the day we rode. Can you imagine being roasted by your front wheel?



Jeff Botsford finding traction where it normally isn't, on the Christini AWD in the rain.

we try. For a more detailed look at what the Christini AWD is all about you should check out www.christini.com or call them—especially if you want to invest millions of dollars in their technology.

Okay. So what Christini does to power the front wheel is this: They take the power from a spot behind the transmission, which, in this case, means the countershaft sprocket. They have doubled-up with a smaller sprocket over top of the countershaft sprocket, which drives a chain around a second sprocket up inside the frame perimeter and about where the inside of your thigh sits. This second sprocket drives a shaft that comes into the back of the steering head, which has been entirely replaced on this frame by one specially designed by Christini. A spiral miter gear in the back of the steering head drives two pinion gears inside the head, which drive two different sets of chain drives that turn the pair of power shafts going down to the front hub. The two shafts are telescoping to allow the suspension to go up and down. The bottom of the fork tubes have been replaced with two drive mechanisms and mated to a modified Excel/Honda hub by another set of drive gears. The machine work on the front hub and drive mechanism is very elegant, and it doesn't look like it could weigh much more than two pounds more than a stock front hub arrangement. There are two drive mechanisms so that the torque to the front wheel is even. Otherwise the bike would want to torque-steer in the direction of a single-sided drive.

Christini's system on this CRF450 is basically full-time AWD—unlike their mountain bikes, there's no switch to shut it off—but it works like a Posi-Traction system. The only time the front wheel drives is when the rear wheel spins or the front wheel starts skidding. Exactly how this works is near the limit of our ability to understand things, but basically there is a pair of clutches in the front wheel that control power output

in the front. The way the clutches are designed, the front wheel is not allowed to go slower than the rear wheel. When the front is losing grip, it is trying to go slower than the rear—take our word for it—which the system won't allow, so the front wheel is immediately "powered" and grabs traction. It basically pulls itself out of a slide. This is what we saw in the Dakar video.

On the Christini system, the power ratio between the front and rear is adjustable. If the front wheel received 100 percent of the rear wheel power you would have to fight to turn the bike, so it is always adjusted down to something easier to handle. When we rode the bike, the front was getting 60 percent of the power of the rear wheel, which Christini says is a good compromise. If there's plenty of traction, the front wheel is free-wheeling forward, the clutches are released and the front wheel is just going along for the ride. In this way, the bike rides like a normal one-wheel drive dirt bike, until you start spinning—which would happen in slick mud, sand, or loose hill climbs. At that point the front end digs in and things get really weird.

And I don't mean bad-weird. As I said above, we went out on the bike just about the time a massive thunderstorm hit, so we hid in the trees until it mostly passed. That left us with puddles of water everywhere and plenty of fresh, wet mud in the low spots. Riding the bike in the woods didn't feel much different than riding any bike, or shall I say riding a normal CRF450R in the woods. They're a little bit of a handful, and in a strange patch of woods one would tend to try to stay focused on keeping the bike upright and not hit anything, two situations that would demand attention that would otherwise be spent trying to feel what the AWD was doing. So in other words, it was hard to tell what was going on.

Soon though, we realized that none of the roots or slippery logs in the woods was giving any trouble.

They didn't even feel slippery, and they should have, considering the tires on the bike. Soon I hit on an idea. I would stop the bike straddling a skinned log and try getting the rear wheel stuck and spinning—a normal occurrence, right? Not on this bike. I would rev up and try to spin the back wheel, and every time the bike would jump right over the log and continue on its merry way. It was not possible to get hung up on a log, but still I wasn't convinced.

Ahead loomed a small, wet swamp. The kind of thing you see on clay-based soil and think, "I wonder if I can get through that?" Piloting the Christini bike into it was a real eye-opener. Where a normal bike would slow down and spin, with the front wheel turning into a rudder while the back end tried to dig to China, the AWD bike charged right through it. More than that, there was the distinct feeling that the front wheel was pulling the bike through. I could feel it in the handlebars, feel the bike lurch forward rather than slow down and spin. Honestly, it's an alarming feeling. You know, you're an experienced rider, you know exactly what your bike is going to do; it's going to spin and you're going to have to dog-paddle to keep from getting stuck. When the bike grinds right through it like it's being pulled by a winch cable, it is very hard to change modes from survival in the mud to just riding through like nothing's happening. Clearly this was where the AWD would shine, but it really would take some getting used to.

We went through that a couple of times and then worked our way into a sand pit. There was loose sand at the bottom and greasy clay-sand up the sides and at the top. We had mixed results at climbing. On the most slippery bits you could again feel the front end pulling you up. However, a big four-stroke is happiest when it is wheelying up a hill, and as soon as this bike lifts its front wheel the AWD advantage is lost, of course. And if you've ridden one, you know how easy it is to loft the front wheel on a CRF450!

Next, in the sand we tried a number of fast, sharp turns, trying to make the rear wheel spin on the exit. When we could make it spin we could physically feel the front tire grab the surface and start pulling, which again is alarming. It's a surprise because 30 years of riding experience tells us what the bike will do in that position, and here it is not doing it. The front wheel driving makes the bike want to stand upright, and then

the pulling sensation from the front wheel makes it seem like it's going to be hard to hold onto the bike, like maybe the bars are going to get ripped out of your hands. I can see that it would take at least a few rides to get used to this AWD bike; but I can also see that once you get very used to the way it sticks to the landscape every other single-wheel drive bike is going to feel nasty.

Is AWD the wave of the future? Of course it is. What other direction do we have to go in? Look at the minor advances in dirt bike technology in the past decade or so, and what else has happened? Very little—power has been increased, suspension components have gotten larger, four-strokes have gotten smaller and lighter (and fuel tanks have gotten way too small!)—but we honestly haven't seen any big breakthroughs in this sport since the emergence of long-travel suspension, or the introduction of viable lightweight four-strokes with the Honda XR line in 1985.

All Wheel Drive is going to be the next major advancement in this sport. At first it will be a specialty item, available on one manufacturer's model, but over time you will see it spread across all the manufacturer's model lines, and one day only the low-end playbikes will be simple one-wheel drive machines. It'll happen, but will it be a mechanical system like Christini's, or a fluid-drive system like the one Ohlins/Yamaha is using, or will it be something we haven't seen yet? Only time and the vagaries of motorcycle marketing plans will slowly reveal all the answers.

Well, as of this issue, the Christini AWD is the first all-wheel drive dirt bike we've ridden, and honestly we have to say that we were totally surprised at both the elegance and effectiveness of the patented Christini system. Unfortunately, as of now you can't buy a Christini AWD motorcycle. This CRF450 is a prototype/working concept that is being paraded around to interested companies, and Christini Technologies hope one day to license their system to one or more manufacturers. From the impression we got on our short afternoon on the bike, we hope they succeed in their quest and that we see production motorcycles with the Christini AWD system on showroom floors within a couple of years. Imagine a bike that couldn't get stuck in the average mudhole or creek crossing. Now tell us you wouldn't want to own that bike. ↑

good layer of mud gave us a perfect replica of Dakar day two to play around in.

Where do we start? We're going to try to explain what's going on in basic terms, but you need to know up front that there is a lot of technology and physics

at work here that we are incapable to describe in any words. For the most part, we at Trail Rider are little more than dumb beasts only capable of riding something and describing what it feels like. Anything more than that and we are out of our league, but lord knows

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