

The story of the Lawson All Wheel Drive concept development **As of March 2016**

Overview

The basic design concept was invented by Martin Lawson. He shared the concept with his father, Bill Lawson, and together they have designed, built, and tested seven ride-able concept motorcycles for off road, dual sport, and adventure riding, and one specifically for racing.

Main goal of the project

Work with a major motorcycle or ATV manufacturer to commercialize the concept for an easy to ride, full power, full time AWD, low impact motorcycle for the trail/recreational/utility market.

Marty's story of the start

"My motorcycle AWD quest began in 2008 when I first saw a Bimota hub center front suspension. I wanted to make something similar, but unique. I quickly realized that the hub assembly of a Bimota front looked awfully similar to a U-joint and that a 4-bar linkage front suspension made power delivery much easier. I also did a lot of web research to find out what other front suspensions had been invented. I ran across information about the Hossack suspension and it was a key inspiration when I evolved my front suspension and drive ideas to suit off-road motorcycles."

"Combining the ideas of the Hossack suspension together with Tony Foale's suspension analysis software and Solid Works with the FEA (Finite Element Analysis) package really helped me design an AWD system that works very well. It allows for full power to the front wheel so you can spin it under almost any circumstances and virtually no rear wheel slip occurs before engagement. It helps the average rider surmount obstacles much easier."

Concept #1: Proving the design

The first proof of concept bike was built in the fall of 2009 by modifying a 1986 TY350, a mellow trials bike from the time before trials' seats got incredibly low. The system worked very well by coupling AWD with a wide-range torque engine. It is still being ridden today, and because of its low weight and low seat height, is an excellent beginner and intermediate AWD bike. The only thing it does not have that would make it even easier to ride is an automatic clutch.

As a result of Concept #1 working so well, Bill filed for a patent in Feb. of 2010 with Martin as the inventor. U.S. Patent # 8042641 was granted Oct. 25, 2011, and international patent applications have been filed to get worldwide protection.

Concept #2: Improving on the design

Even though Concept #1 worked well, it was a rough model and not based on a modern motorcycle. Many people could not see past the old bike to understand the benefits of the Lawson AWD system. A friend, an ex nationally rated Motocross racer in his misspent youth, recommended the next design be based on a modern enduro bike like the KTM 300, a two cycle motorcycle with a very powerful motor and a long travel suspension designed for off road racing. Bill found a 2004 KTM

300 EXC at a reasonable price and together he and Marty adapted the motorcycle during the winter of 2010- 2011. The KTM is the motorcycle Marty rides. It is street legal and works well for the average rider.

The summer of 2011 Bill and Marty rode Concept #2 at various events and also had a racer, Pete (Speedy) Laubmeier from Madison, WI, try it out. He liked it but thought it was not yet quite what an expert racer would want to ride. Speedy said, however, he would like to try a "race ready" version in the 4 or 5 races he rode every year (Hare Scrambles, Enduros) where the terrain was gnarly enough with sand, river rocks, mud, etc., that the all wheel drive could make a difference.

Concept #3: Race testing the design

As a result, Bill and Marty decided to build the next bike for racing and fix some minor things that were OK on Concept #2 but not quite as good as they should be. They bought a 2011 KTM 300 XC from Speedy after the 2011 racing season and Marty proceeded to design the next version. When that bike was finished late in the summer of 2012 Speedy raced it in several races with good results. Bill and Marty learned some minor things that needed to be changed but in general it worked very well. Speedy even raced it in a GP Ice Race where he was challenging for the lead on Lap 13 when unfortunately a snap ring failed on a bearing in the front drive system and the front wheel drive ceased to work. There was no catastrophic failure such as the front wheel locking up but by the time the pit crew, Marty and Bill, figured out what was wrong, the race was over.

Concept bike #3 works very well, and is being demonstrated and ridden frequently. However, because some compromises were made in the interest of parts availability and conservative design, it is heavier than it should be. After further testing to fully understand the stresses, and improved design to provide lighter weight parts, Bill and Marty think enough weight can be taken off the front suspension system to keep the weight increase compared to the standard bike to less than 20 lbs total additional.

Concept # 4: Testing advanced drive design

A fourth design has been built to test advanced drive concepts including using a special limited over/underdrive differential to prevent wheel spin if either wheel is unloaded. The unique differential design has worked fine.

Now the Concept #4 bike has been modified to utilize the operator control the positive overdrive system using an electric clutch with a planetary drive controlled by a switch on the handlebars to engage or disengage the system. We have tested this concept for positive overdrive and it works well. Now this second system will test how the operator can use the system for on-the-fly engagement and disengagement. The patent application for the over drive system has been allowed and the patent will be issued in several months. This system will provide the ultimate in steerability under all conditions.

Concept #5: The ideal AWD dual sport test bike

The fifth concept motorcycle based on a 2013 KTM 350 EXC-f dual sport bike demonstrates the utility of dual sport and adventure bike use. It has been extensively tested in various conditions including in very difficult conditions in the

Colorado mountains and in a KTM adventure bike rally. The total drive system on the 350 has proven to operate well at up to 92 mph. It has the ability to engage and disengage the front wheel drive system when the bike is stopped so that for high speed travel on roads, etc., the noise of the front wheel drive is reduced. It is not necessary, though, because the front wheel drive engages at about 1% slip, it normally never supplies any power when riding on hard surfaces. An electric clutch could be used with this system so it would have on the fly AWD engagement like is available on many 4WD trucks. The Dual sport concept motorcycle is currently under test by a major off road motorcycle magazine and an article is being written at this time.

Concept #6: The ideal lightweight off-road bike

The sixth Concept motorcycle was built using a Sherco 3.2 four stroke trials bike as a base. The objective was to build and test a very lightweight off-road motorcycle. The front suspension design was built with a shorter travel (7 inches) to allow the bike to be much lower and also set up with less anti-dive and more shock absorption. With its light weight, low seat, and very smooth torquey engine, it makes a very versatile, easy to ride trail bike.

Concept # 7: The ideal recreational/utility All Terrain Motorcycle to complement ATV, UTV uses

The seventh Concept motorcycle is based on a lightweight AJP PR4 motorcycle which has a very reliable four-cycle 230 CC engine with electric start. Essentially it was designed to be an easy-to-ride vehicle that can go where an ATV or UTV can't because of narrow trails, difficult steep situations and steep side hills, etc. In addition, as it is road legal, it can travel between off-road areas. This All Terrain Motorcycle can be equipped with an automatic clutch, luggage rack, single wheel trailer, for even easier riding and hauling of additional equipment by the inexperienced rider. The All terrain motorcycle concept is currently under test by a major off road motorcycle magazine and an article is being written at this time.

The Inventors

Martin (Marty) Lawson has a bachelor's degree in mechanical engineering and a master's degree from the University of Wisconsin-Madison in mechanical engineering control systems. He works for the Space Science Center at the U of W as an Instrument Innovator developing Lidar systems for weather research. He is a hands-on engineer, proficient in using all types of equipment such as the CNC equipment in the machine shop.

William (Bill) Lawson, P.E., graduated from the University of Wisconsin-Madison with a degree in mechanical engineering and an almost Masters in mechanical engineering from the University of Minnesota. He is a retired company owner and engineer who worked many years designing and building industrial laser manufacturing systems. He loves to design and build all kinds of stuff in his own fully equipped machine shop. He holds fourteen patents.