Knowledge

WHAT WE NEED to know can sometimes be learned very effectively from books. And sometimes not. I've been a voracious reader on technical subjects about cars and motorcycles for a long time, and always made sure that I thoroughly understood what I read.

For instance, I remember one of my students being amazed that I didn't need a manual to arrange the ignition system on a small block Chevy he'd just rebuilt. But it was simple logic in my mind. Some things can be so completely understood by reading books that independent investigation isn't really necessary.

But some things are not well understood, and even finding information on them can be difficult. Gyroscopes, for example. I remember once going to a library trying to find information on that subject and the only book they had was the "Little Golden Book of Gyroscopes" with maybe 12 pages written for children. But if you stop to think about it, any spinning part of a motorcycle, from its wheels to its internal engine shafts will behave like a gyroscope to some degree.

I think it's fair to assume that you are all sophisticated enough about the subject to know that the more weight, the more rpm and the greater the weight's distance from the axis, the more powerful the gyroscope—meaning that wheel assemblies and engine crankshaft/flywheels are by far the most significant on a motorcycle. Wheel assemblies turn relatively slowly but, because their diameters are large and much of their mass is concentrated at their outer edge, make very strong flywheels. With engine cranks/flywheels, although they are much smaller in diameter, the weight is heavy and their rpm can be very high, making them equally significant.

A little quick calculation shows that a 180/50 tire on a 17" wheel will spin at roughly 838 rpm at 60 mph. If you've ever tried to spin a wheel and tire when someone held it by the ends of its axle, you know how hard it can be to achieve the same nearly 14 revolutions in a second, but whatever speed you can muster will make an unforgettable illustration of gyroscopic precession—probably my favorite classroom demonstration. Asked to imitate the motion of turning a front fork with their arms acting as the fork legs, my students would be shocked by the contrary resistance created by the gyroscopic force. For instance, when "steering" the leading edge of the front tire to the right, the top of the spinning assembly would wrestle itself powerfully to the left, at 90° to the motion

applied to the axis. This isn't a physics lesson, so I won't go into more detail, but don't miss the opportunity to try it yourself if you ever have one of your wheels removed—and hold on tight!

Now, stop to consider that your motorcycle is comprised of three gyroscopes, not just the two wheels, but also the spinning crank/flywheel, so it doesn't behave like a simple bicycle. The effect of the engine's gyro force creates a powerful additional resistance to turning.

Simple devices reveal first principles more clearly than complex ones, which is probably why I like go-karts and single cylinder motorcycles so much. The significance of this third gyro was brought home to me most clearly on two very simple machines. One was a very light single-speed moped, which could be thrown into corners with shockingly quick directional changes. Looking for more speed, I converted the simple clutch to a variator-type with a torque-convertor to gain variable drive ratios. The variator weighed perhaps a pound or so more than the original clutch. The surprising result was that although I had gained better acceleration, the machine simply refused to be thrown into turns as easily and acted much less like a bicycle.

My TT500 Yamaha was the other example. Back in the late '70s,when four-strokes were first attempting to offer an alternative to two-stroke dirt bikes, and Carlsbad Raceway would have a Four-stroke GP every year, I never missed it. But sadly, the Yamahas didn't have the handling of the Hondas. The TT500 refused to change direction by comparison. You guessed it—flywheel weight.

Now, four-stroke singles need relatively heavy flywheels so that the engine doesn't come to a stop as the crank rotates 720° and the piston does the work necessary to reach the next combustion phase, especially when it is spinning slowly. But enough is enough. Once at higher rpm, that additional flywheel weight just slows response. I was tempted to remove weight from my stock flywheel, but I'd heard too many reports of lightened units blowing up. A certain Husqvarna flywheel would fit and was lighter, but a costly modification out of my budget.

However, the rpm of the crank makes another interesting variable. When our local dirt-riding areas closed and I converted the bike for the street, I regeared it for higher speeds. This provided another revelation: It was remarkable how much faster the bike could be turned if I didn't downshift, but let the engine pull a lower rpm—because the effect of the third gyro was greatly reduced.

I pay attention to experiments. Suzuki had a system that allowed a separate flywheel weight to be centrifugally disconnected when engine rpm reached a given speed, to enable better response from an otherwise slow-revving single—very clever.

To reduce the steering inertia introduced by the third gyroscope, Yamaha (among others) has experimented with reversing the engine's rotation (which has traditionally been in the same direction as the wheels, to minimize the number of shafts in the engine). Valentino Rossi's championship-winning MotoGP bike uses such a design, although the same trick didn't seem to have the desired effect on Yamaha's vertical twin dirt-track bikes years ago.

And, those bolt-on flywheel weights, popular for motocross bikes converted for enduro use, will do much more than simply slow engine response for more traction.

I've recently found that the really excellent inexpensive toy gyroscopes we used to be able to buy as kids are no longer available. The look-alike new ones are not well-balanced enough to spin horizontally supported only by one end—an amazing sight that needs to be seen with our own eyes to appreciate how phenomenal it is.

Sometimes the only way to learn more is to experiment, so that we can really understand how our motorcycles work.

Dave Searle

—Dave Searle
Editor