

# Open Road

## Chain Of Fools

CONSIDER THE VARIOUS mechanical infirmities that we associate with a motor's old age: hard starting, carburetion that's lost its crisp edge, weakened compression, an ignition spark that doesn't light your bike's fire with the same youthful enthusiasm.

Like riding an old horse, we have to spur some extra revs to move out from a stop, or kick down now for the same grades that our mount barely noticed when it was new.

But motorcycles aren't biological systems doomed to entropy. They're metal, responsive to cutting tools and restored clearances that would be the envy of hospital surgeons.

If you're the sort that doesn't stand still while your favorite propulsion system gets geriatric, you may have found to your dismay that modern moto-medicine often fails to put all the new back in, even when you pay for expensive private coverage.

The mechanic says the ignition components check out fine; they're not the problem. The carburetors can get a spotless cleaning and exacting synchronization, but they still don't feel right. You consider spending thousands on flatslides. Even a top end overhaul (pistons, rings, valves, seats and more) may actually fail to fully restore the thrust. "Let it break-in, it'll get stronger," the technician says, folding your money and hoping you'll stop complaining and just go away.

Been there? Done that? Plenty have.

The missing link in this puzzle, perhaps the most overlooked maintenance item in motorcycling, may just be the cam chain.

Because four-stroke engines make just one power stroke for each two full turns of the crankshaft, the camshaft is turned at half the crank speed, so that one turn of the cam can control the valves through two turns of the crank. This is accomplished by using gears or sprockets. Two are enough, in which case the one on the crank will be half the size of the one on the cam. The drive is usually handled in one of three different ways: with gears, belts or chains. The pros and cons are that gears are very expensive and often noisy and transfer combustion shocks to the cam, but never get out of adjustment. Belts are inexpensive, self-damping and quiet, but must be regularly replaced before they simply snap and cause the cam to stop turning, which can cause disastrous collisions when the pistons continue reciprocating (Ducati's latest spec is two years or 15,000 miles between cam belt replacements, for instance). Chains, on the other hand, are also relatively cheap, fairly quiet and damp shocks better than gears



but will stretch considerably, although they rarely break.

Cam chain manufacturers will tell you their chain doesn't actually stretch, but elongation happens when combustion shocks, the centrifugal force of overrevving, overtightened tensioners, worn or cocked guides or dirty oil causes lubrication to be momentarily forced out of the chains' joints. The resulting friction between pins and bushings allows galling, resulting in the increased clearances we call "stretch."

How much is too much? Some service manuals indicate 1.5% as a limit, determined by precisely measuring the distance between a given number of pins.

Imagine a typical DOHC engine, assuming its cams were perfectly aligned when new (a big assumption, as variations in cam timing due to manufacturing tolerances can be the biggest difference between the power of otherwise identical brand-new motors). If our hypothetical engine has 12" of chain between the crank and exhaust cam and a cam sprocket 3" in diameter, 2% stretch will allow .24" of rotation on the sprocket, which works out to 9.23° of retarded timing. If we have another 6" of chain between the exhaust and intake cams, the intake will be retarded by a total of 13.84°. This is an extreme situation, but illustrates the point. Just 4° of variation is considered the most an engine can tolerate efficiently.

The effect of this stretch is that the intake valve closes very late, reducing the trapped charge and effective compression. The overlap period is skewed and shortened, and the strong vacuum of the intake stroke is reduced, which makes the carburetion

less effective, losing its crisp responsiveness. And the ignition, which is often triggered off the camshaft, can also be retarded, reducing power and mileage and increasing emissions.

Retarded timing also shifts the powerband higher at the expense of the low-end. Crane used to sell cams with adjustable timing positions for H-Ds; stock and plus or minus 4°, which they noted moved the powerband by 400 rpm in either direction, or by 100 rpm per degree of movement.

And let's not forget that in many high-performance engines the valves dance very close to the crowns of high compression pistons, and delayed timing can cause broken exhaust valves, causing total destruction.

So why isn't cam chain replacement a more routine part of engine maintenance? Because cam chains are endless loops and the effort to replace them unbroken can be nearly endless, also. Not only must the cams come out, but typically the crankshaft as well. Many engines drive the cam from the middle of the crank, which precludes slipping the chain off the end of the crank, as you can on domestic V-8s, for instance.

Alignment marks on the cam sprockets will usually quickly reveal their angle of misalignment and some high-performance engines do provide adjustable cam sprockets (Kawasaki and Ducati are two that do), so corrections to minimize emissions or maximize performance can be accomplished without buying adjustable cam sprockets or slotting your own.

Note, too, that special high-performance cam chain is also available for racing applications. Only slightly more expensive than OEM grade, it's made of higher strength materials and finished to higher tolerances should you choose to rebuild your motor.

Years ago, you could buy cam chain with a master link to ease the job. But after witnessing a friend's sad experience with a master link failure that turned his Honda to junk, I'm not sure I could ever trust the idea. However, many racing go-karts now use motorcycle cam chain for drive chain, and the tools to break and re-rivet this chain are available. My own go-kart has had no problems with this arrangement, and it certainly is much easier to accomplish.

Don't forget that hard-working part of your motor just because it's out of sight.

Its effects are almost unbelievable. Cheers!

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