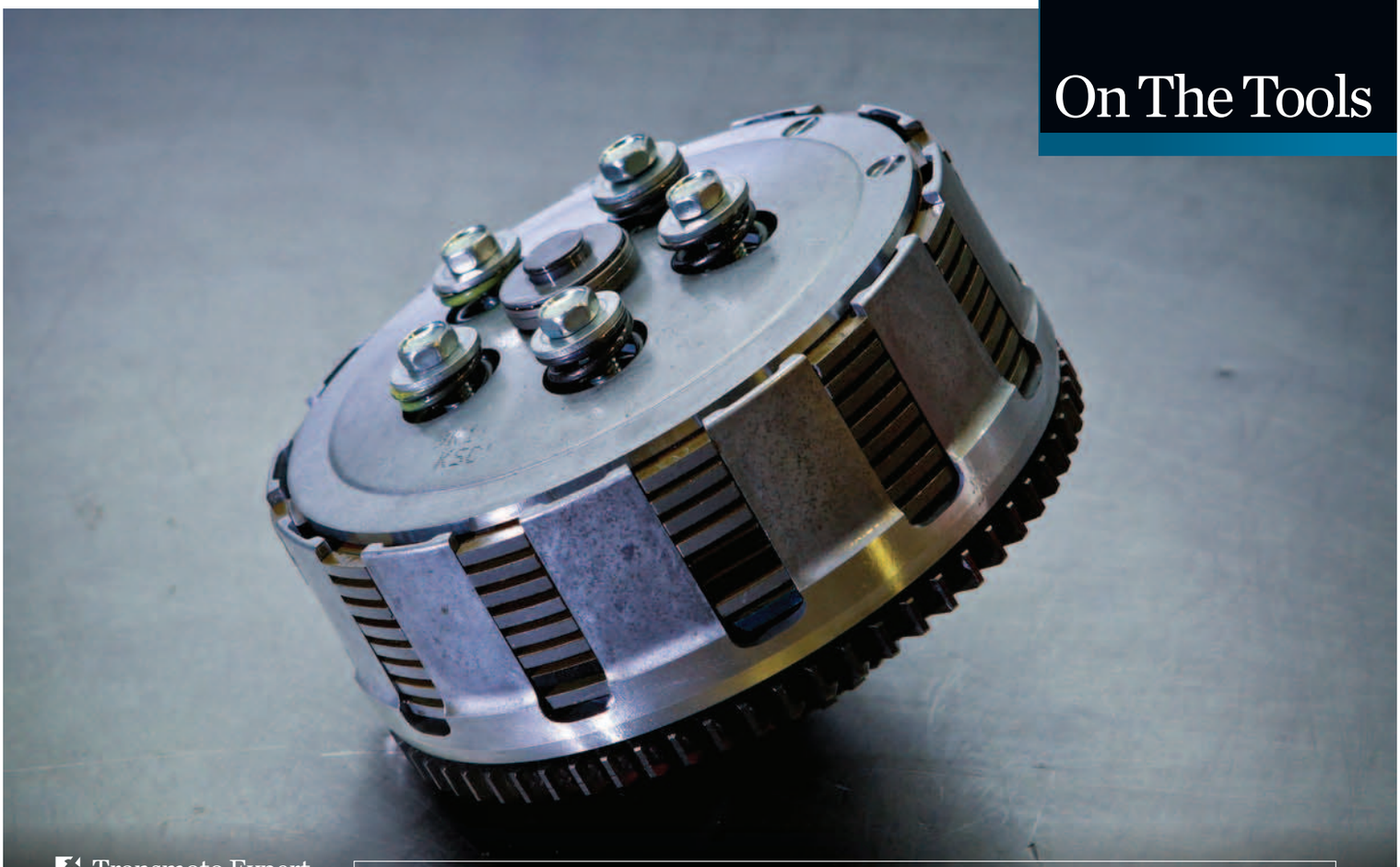


Transmoto Expert

WHO DA DOLE?

Nick Dole owns and operates Sydney-based suspension business, Teknik Motorsport. In the past decade, the man has tuned suspension for the Ballard's Offroad team, performed engine and suspension work on Australian Safari-winning GHR Honda XR650s, run a Kawasaki Pro Lites team in the Aussie MX Nats, worked as an independent technical consultant for magazine test programs, and dealt with just about every punter and butchered dirt bike to ever roll into a workshop. We reckon that qualifies him to offer up credible advice about how to get the most out of your spend at the local workshop.

CLUTCH DIAGNOSTICS

Understanding the critical connection between your engine and rear wheel.

NICK DOLE IAN HANCOCK

The clutch is the poor tortured device that sits between your engine's crankshaft and the back wheel, controlling the transmission of power. Some riders barely use it, while others use their clutch as a power modulater, brake, wheelie device, or gear-too-tall-and-I-don't-want-to-shift device.

We typically don't think about our clutch until it starts to slip or begins to feel jerky. Many riders reckon the friction (drive) plates are the only parts that wear, but all clutch components have a lifespan and will cause the deterioration of a clutch's performance as they wear.

In simple terms, the clutch assembly is made up of a basket that is driven by the primary-drive gear off the crank, a hub that sits in the basket and locates both the clutch plates and splines onto the mainshaft, and a pressure plate that forces the clutch together to provide friction, and therefore drive. The drive plates and driven plates are commonly called friction plates and steel plates, respectively.

Drive plates are traditionally made from cork, but as this natural resource becomes more expensive, we are now seeing plates made from paper. The driven plates are commonly steel, although aluminum driven plates are often used in MX applications, as a heavy clutch assembly has a significant flywheel effect.

Four, five or six coil springs are used to compress the pack, with a throw-out bearing pushing against the spring tension to disengage the pack. The clutch springs are usually a coil, although diaphragm springs are commonplace on road clutches.

Over the next few pages, we'll explain how these parts work, what goes wrong with them, how to diagnose problems and how to fix them.

DIRT BIKE CLUTCH ABUSE

To put a dirt bike's clutch into perspective, when you drive down to the shops in the car, do you take a corner in fourth gear when you really should be in third, and just fan (slip) the clutch to break the back-end loose and get the engine up into the power? No. Do you hold the throttle flat and flick the clutch to change gears? No. In a recent *Top Gear* celebrity driving challenge, the clutch on their brand-new reasonably priced car lasted for only 26 miles of abuse ... the sort of abuse that would be considered normal on a dirt bike!

Road bikes don't suffer the same sort of clutch abuse, either, as they generally have more power and, as you're always trying to be smooth, fanning is rare. Generally speaking, the larger the engine capacity, the less abuse the clutch will have to endure. For example, keeping a 125cc two-stroke in the meat of the power entails using a hell of a lot more clutch than a 530cc four-stroke. It's also rider-dependant. If you just hold the throttle open and modulate power delivery with the clutch – common among fast off-road riders – wear occurs fast.

Single vs Multi-Plate Clutches

The alloy hub on the lower left is a multi-plate dirt bike clutch, while the other three parts make up the single-plate clutch of a small car.

On the face of it, single-plate clutches – found in cars, 4WDs and trucks – look a whole lot simpler than a dirt bike's complex multi-plate clutch, but there's good reason for it.

Multi-plate clutches are at the pointy end of the clutch world, being used on F1 and top fuel cars. Advantages include better feel from the larger surface area, a more controllable engagement point, more plates to share the wear, and oil to dissipate heat and contaminants.

We can often get away with only changing the drive plates in a motorcycle, but we are leaving ourselves open to problems if the other wearing parts – that are replaced in cars – are not inspected. For example, when you replace a car's clutch disc, you also replace the pressure plate, spring(s) and throw-out bearing, and machine the drive hub.

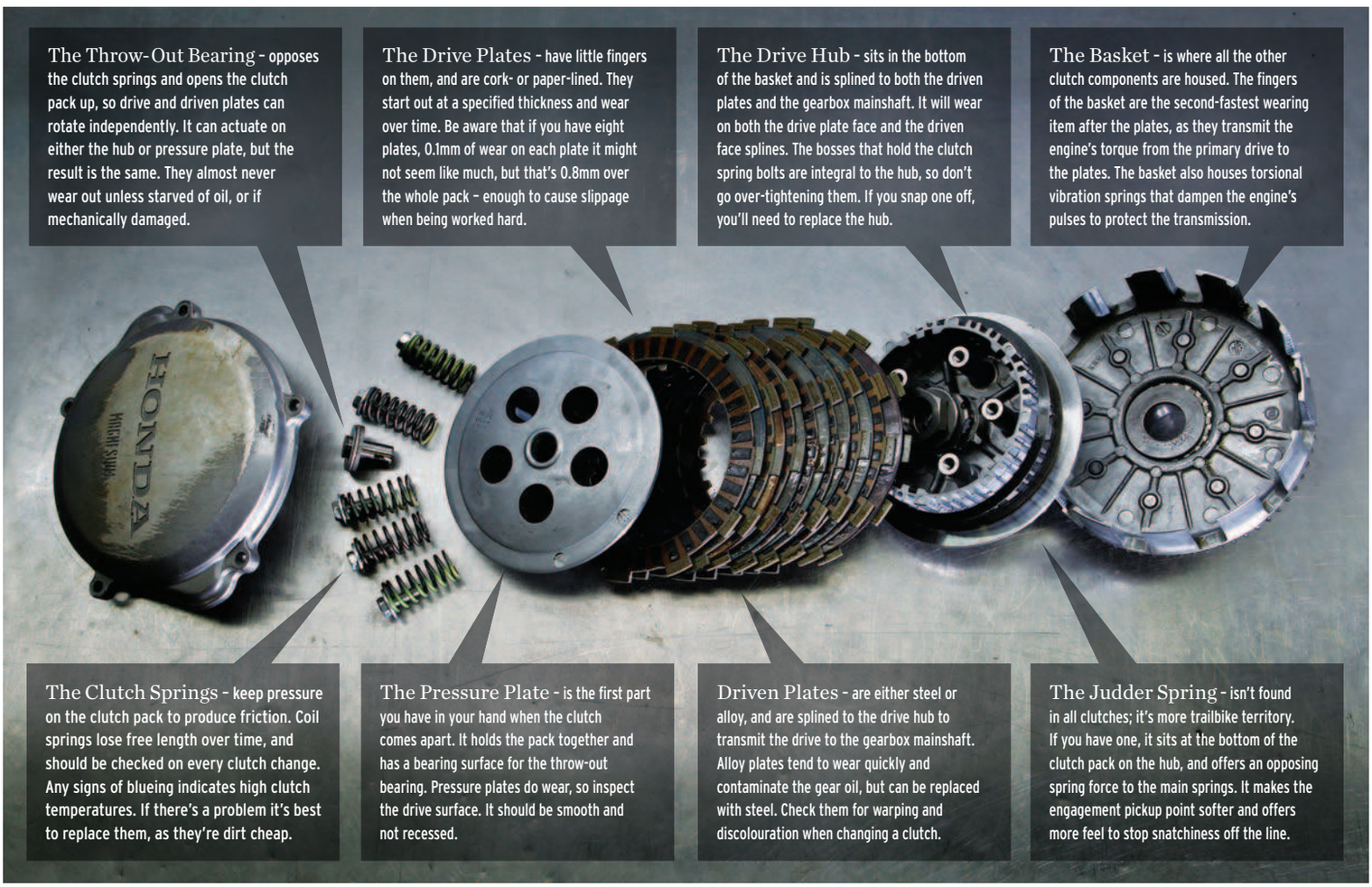
The other important aspect of the multi-plate clutch is the overall pack thickness, and this is where you can come a bit unstuck using aftermarket plates. If you're after replacement aftermarket wear plates, then it's not only the physical dimensions that are critical – it's also the thickness. If we have eight fibres at 3.0mm each and seven steels at 2.0mm, that's a pack thickness of 38mm. By using aftermarket 2.8mm fibres, we have lost 1.6mm of thickness from the overall pack, significantly reducing the spring clamping load. It always pays to check the overall pack height, as we've even seen this problem happen with respected aftermarket suppliers.

The Throw-Out Bearing - opposes the clutch springs and opens the clutch pack up, so drive and driven plates can rotate independently. It can actuate on either the hub or pressure plate, but the result is the same. They almost never wear out unless starved of oil, or if mechanically damaged.

The Drive Plates - have little fingers on them, and are cork- or paper-lined. They start out at a specified thickness and wear over time. Be aware that if you have eight plates, 0.1mm of wear on each plate it might not seem like much, but that's 0.8mm over the whole pack – enough to cause slippage when being worked hard.

The Drive Hub - sits in the bottom of the basket and is splined to both the driven plates and the gearbox mainshaft. It will wear on both the drive plate face and the driven face splines. The bosses that hold the clutch spring bolts are integral to the hub, so don't go over-tightening them. If you snap one off, you'll need to replace the hub.

The Basket - is where all the other clutch components are housed. The fingers of the basket are the second-fastest wearing item after the plates, as they transmit the engine's torque from the primary drive to the plates. The basket also houses torsional vibration springs that dampen the engine's pulses to protect the transmission.



The Clutch Springs - keep pressure on the clutch pack to produce friction. Coil springs lose free length over time, and should be checked on every clutch change. Any signs of blueing indicates high clutch temperatures. If there's a problem it's best to replace them, as they're dirt cheap.

The Pressure Plate - is the first part you have in your hand when the clutch comes apart. It holds the pack together and has a bearing surface for the throw-out bearing. Pressure plates do wear, so inspect the drive surface. It should be smooth and not recessed.

Driven Plates - are either steel or alloy, and are splined to the drive hub to transmit the drive to the gearbox mainshaft. Alloy plates tend to wear quickly and contaminate the gear oil, but can be replaced with steel. Check them for warping and discolouration when changing a clutch.

The Judder Spring - isn't found in all clutches; it's more trailbike territory. If you have one, it sits at the bottom of the clutch pack on the hub, and offers an opposing spring force to the main springs. It makes the engagement pickup point softer and offers more feel to stop snatchiness off the line.

CLUTCH DISASSEMBLY

1 Brake Calliper

Push down hard on the brake calliper to make the brake lever floppy. This gives you access to the clutch cover without removing the lever – easy.

2 Remove Clutch Cover

Try not to tear the gasket when you unbolt the clutch cover, as it can be re-used. Then use the cover to house all the other parts you pull off the bike.

3 Loosen/Remove Springs

As you remove the springs, note if they are directional. If so, there'll be paint marks, or the springs will be progressive or beehive in design.

4 Remove Clutch Pack

Remove the clutch plates as a stack. Hondas have a neat little holes for oversize fingers. Note down the pack order if the first and last plates differ from the rest of the pack.

5 Remove Throw-Out Bearing

There is sometimes a ball bearing under the throw-out bearing, so be careful as you remove it. Dropping it into the transmission is no fun. Fishing, anyone?

6 Flatten Lock Washer

Use a sharp steel cold chisel to flatten the clutch hub nut lock washer. The wooden type can crack and splinter, contaminating your oil.

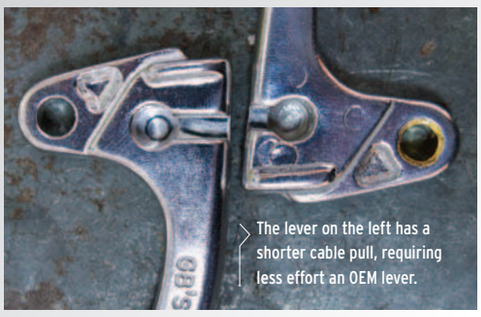
7 Loosen Clutch Hub Nut

An air impact gun is the easiest way to loosen the clutch hub nut, but you can use a spanner by putting the bike in gear and holding the rear brake on.

8 Remove Clutch Basket

With the nut removed, simply pull out the clutch basket. Keep an eye out for thrust washers and bearings that could fall into the transmission.

LEVERS



The lever on the left has a shorter cable pull, requiring less effort an OEM lever.

With enough leverage you can move the world, right? There are a few leverage points at work in both cable and hydraulic clutches, but the bottom line is that there is a trade-off between total lever movement and the effort to pull the lever in.

There used to be a trend towards shorty levers as they were more comfortable and crash-proof, but they make the clutch heavier to pull due to less leverage. The gumby-looking long levers give you greater mechanical advantage. There is also the option of moving the lever pivot point so it takes less effort to move the cable, but this comes at the cost of reduced cable travel. This is seldom a problem for race bikes, but can lead to clutch drag – and extreme heat – in trailbikes that sit for extended periods in first gear with the clutch in. You can also extend the actuating arm at the gearbox for the same effect.

CLUTCH CABLE

Why do we still use cables when hydraulic clutches have the benefits of being self-adjusting, not drying out, or getting full of dirt and giving you arm-pump in a nanosecond? There's two reasons – cost and feel.

The cost benefit of cables isn't just in the initial manufacturing, but also maintenance. Cables do wear out, but they are cheap to replace (unlike hydraulic clutches). Don't bother trying to lube an old, dry, worn-out cable when $30-$50 will get your clutch feeling like new again.

In terms of feel, the pack only has to be separated by tenths of a millimetre to alter the amount of clutch plate slippage. A cable has none of the dampening effects found in a hydraulic clutch that result in a loss of feel, but you need to be pretty damn fussy (fast) to tell the difference.

Cable clutches can have a light pull with proper maintenance.

HYDRAULIC CLUTCH

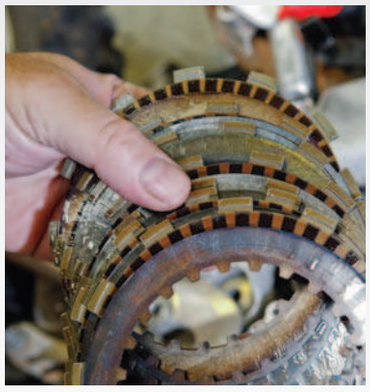
Retro-fitted hydraulic clutch kits were popular in the late '90s on Japanese bikes, but they were usually a poorly laid-out mess that was just waiting to fail. KTM changed our perception of how good a hydraulic clutch can be, but the downside used to be the frightening bill if you broke it. Now they're not that expensive, with plenty of aftermarket parts available.

Fluid choice is always a cause for confusion. Magura recommends their own bio-hydraulic 'blood' oil, and Motorex makes a very good hydraulic clutch fluid. In a pinch, we've seen blokes use everything from 3wt fork oil to automatic transmission fluid. Brake fluid will work too, but isn't good for the seals and lines.

A chain derailment can smash the slave cylinder, so a guard is well worth having.

CLUTCH CHECKS/DIAGNOSICS

How do you know when your clutch is unhappy? There are a variety of symptoms, from a hard lever, dragging, slipping or a hard-to-find neutral, but most are easy and cheap to fix. Below is a list of the common symptoms, the associated problem, and what's needed to fix it. These parts should all be checked when you have the sucker apart as a preventative measure, too.



Worn Drive Plates

Symptoms: The clutch slips under power; especially under hard acceleration in the mid-range.

Problem: The paper or cork is worn out or burnt, and can't maintain friction against the driven plates.

Fix: Replace the lot.

Typical Cost: $65-$200, depending on the number of plates and whether you go OEM or aftermarket.

Warped Driven Plates

Symptoms: Hard to find neutral and a long engagement point. You've inspected the basket for notches, but it's fine.

Problem: The driven plates are warped from heat. Put the plate on a piece of glass and try to slide a thin feeler guage under it.

Fix: Replace 'em. Just the warped ones if you're tight, but ideally all of them.

Typical Cost: $40-$120, depending on the number of plates.

Small Pack Height

Symptoms: You've replaced the drive plates and springs, but the clutch still slips.

Problem: You bought non-genuine plates so the overall pack height is thinner than stock. The spring preload is lowered.

Fix: Work out what the pack height should be, and use the bogus plates as ninja throwing-stars at the parts man.

Typical Cost: Bad mood, lost riding time, ridiculed by your mates.

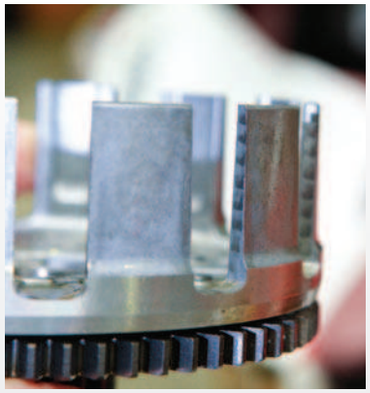
Worn Springs

Symptoms: You have just thrown a set of fibre (drive) plates in to cure your slipping clutch, but the clutch slips again after a short while.

Problem: The clutch springs have lost their free length over time, and can no longer create the necessary pressure to create friction.

Fix: Replace 'em. It's quick, cheap and easy.

Typical Cost: $35-$50.



Worn Basket

Symptoms: Hard lever action with a new cable, bike jumps when you engage a gear, hard to find neutral, clutches don't last.

Problem: The basket fingers have grooves in them.

Fix: File them out if you are stuck or tight, or buy a new one. A Hinson or Wiseco basket/hub/pressure plate combo is a good idea if you are a serial clutch abuser.

Typical Cost: 15 minutes with a file, or $250-$600 for a new basket.

Worn Damper Spring

Symptoms: Clutch rattles at idle, and is worse in neutral. There's also backlash in the transmission.

Problem: The springs in the back of the basket have worn and need replacing.

Fix: If you're lucky you'll get away with new rubbers and springs, but you'll usually need a new basket. Aftermarket baskets don't include the drive gear, so you'll need springs separately.

Typical Cost: $300-$500

Worn Throw-Out Bearing

Symptoms: A rattly noise when you pull the clutch in.

Problem: The throw-out bearing has had the sword. If it has overheated it will have a blue tinge. If there's mechanical damage, munched steel should be a giveaway sign.

Fix: Newbie required.

Typical Cost: $10-50.

Flat Judder Spring

Symptoms: The clutch has lost its long, smooth engagement point, and is now either in or out.

Problem: The judder spring, usually a convex shape, has gone flat.

Fix: Get a new one, and use the flat item as a hamster hula-hoop.

Typical Cost: $25

On The Tools

AUTO CLUTCHES

There are a few auto clutches on the market, which all differ slightly. They are similar to a centrifugal clutch in that when the engine is idling, the clutch is disengaged. This disengagement point can be altered to a designated engine RPM, so engine braking is not lost on slow hill descents. The clutch lever will still operate as normal, with a lighter or heavier feel, depending on the product.

The main advantage is that you can't stall the engine, so you spend less time fussing over the clutch at low speeds and in difficult sections like hills. It's also harder to stall the engine with the rear brake, and poor clutch control is a thing of the past – just twist the throttle and go.

SLIPPER CLUTCHES

It's possible to over-rev any engine mechanically. For example, if you come into a corner in fourth gear, bang it down two gears on the entry and let the clutch out, the rear wheel will spin the engine over faster than the rev limiter is set to. This is a common source of four-stroke engine failure, so a clutch that could slip on over-run was invented, also known as a back-torque limiter, or slipper clutch.

A slipper clutch can eliminate over-rev, and reduce the mechanical drag that compression braking brings. Another benefit is that, as the chain is not loaded up, the suspension works better, and the bike is more settled in corners.

Road racers have used slipper clutches since the '80s, but owners of four-stroke motocrossers are starting to catch on to the benefits. They take a bit of setting up, as the point of slip/grip is dictated by the thickness of the whole pack, plus some optional cams and springs.

CLAKE LEVER

The Clake is a cool Aussie invention that looks like a hydraulic clutch, but with two master cylinders. One's for the clutch, and the other the rear brake. As you pull the lever in, the clutch disengages first, and then the rear brake is actuated as you get closer to the bars. The engagement points are adjustable, so you can get more or less brake/clutch. The rear brake pedal remains, and the clutch can still be feathered and fanned as normal.

Originally designed by a rider with a bad ankle, the advantages are numerous. You always have access to the rear brake, so right-hand turns and steep downhills become much easier. It also provides greater feel for the rear brake.

THE FUTURE

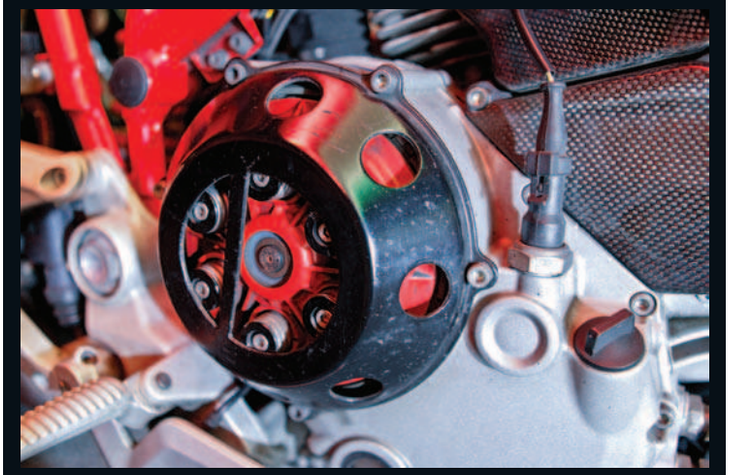
Constantly variable transmissions (CVT) have been used on scooters for decades. There has always been talk of them branching out of the scooter niche and into other motorcycles, but it has never happened. That's because the drive belt is a weak link, and wouldn't like the type abuse dirt bikes would throw at it. The need the keep the swingarm pivot and rear axle pivot the same length makes it interesting, too.

Honda invented an infinitely variable transmission that featured on the bike that won the All-Japan Motocross Championship in 1991, but all development on the technology seems to have gone quiet.

Husqvarna made three- and four-speed auto gearboxes in the '80s, but they had a few reliability problems. When it was going it was great, with all the advantages of an auto clutch but no gear changes. But there was no engine braking whatsoever! Hopefully one day they will return.

There have been factory prototypes of electronically-controlled transmissions for many years, but none have made production. In a dirt bike, simple is usually best, as there are fewer parts to break.

WET vs DRY



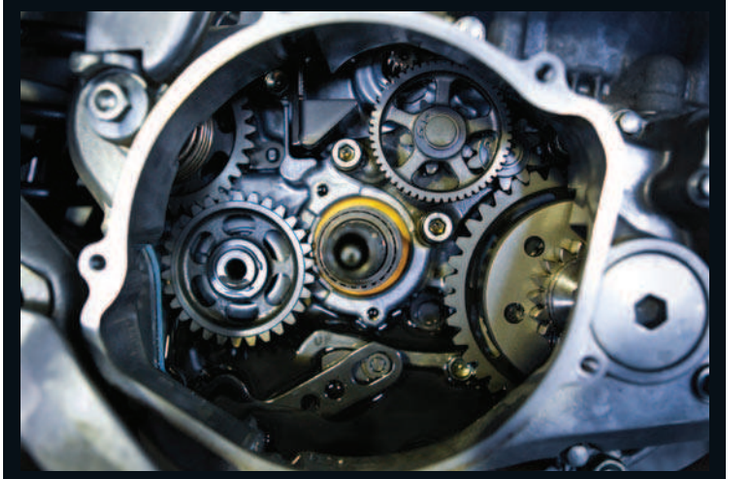
Dry clutches were last seen on dirt bikes in the late '80s on factory bikes, but were lost when the AMA went to the production rule in 1986. Cagiva hung onto the dream for a few years in 125cc MX GP, but you won't hear the distinct rattle at a motocross track today.

They have some advantages over a wet clutch, being fast and easy to service on the side of the track, with no oil loss. There's also no engine oil contamination and cavitation, and the whole gearbox casting can be made much smaller. They are generally smaller for a given power output, too.

But there're plenty of downsides, which is why all dirt bikes and most road bikes use wet clutches today. Dry clutches are loud and rattly, produce mountains of black dust, the baskets wear as fast as the drive plates, and they overheat in seconds when stationary and disengaged.

Today, you'll only hear the rattle of a dry clutch as a Ducati rider fetches his café latte, drowning out the exhaust noise from his twin 54mm pipes.

OIL CHOICE



The oil that lubricates your clutch has to have some unusual properties. It needs to be capable of absorbing the shock loading of the transmission gears and lubricating the transmission bearings, but can't do its job so well that the clutch isn't capable of grabbing.

As the clutch relies on friction, the wrong oil can cause headaches. Some automotive engine oils contain additives such as friction modifiers, but the additives will permiate the clutch plates and give you a slipping clutch. The best oil for a clutch is an automatic transmission fluid, as it's designed for wet cork clutches and the planetry gears found in automatic car transmissions. Unfortunately it's not designed to handle shock loading, which is very common in a dirt bike as it gains and breaks traction. ATF fluid can be used in a pinch in two-strokes, but it's better to use specialist gearbox oils for wet clutch motorcycles.

Four-strokes that share the engine and transmission oil make for a bigger dilema, as the oil has to cope with an internal combustion engine as well. Clutch slipping and drag issues can still occur with some big-name specialist motorcycle oils, so if you feel your clutch is not working as well as it once was and you have changed oil brands recently, try another brand.