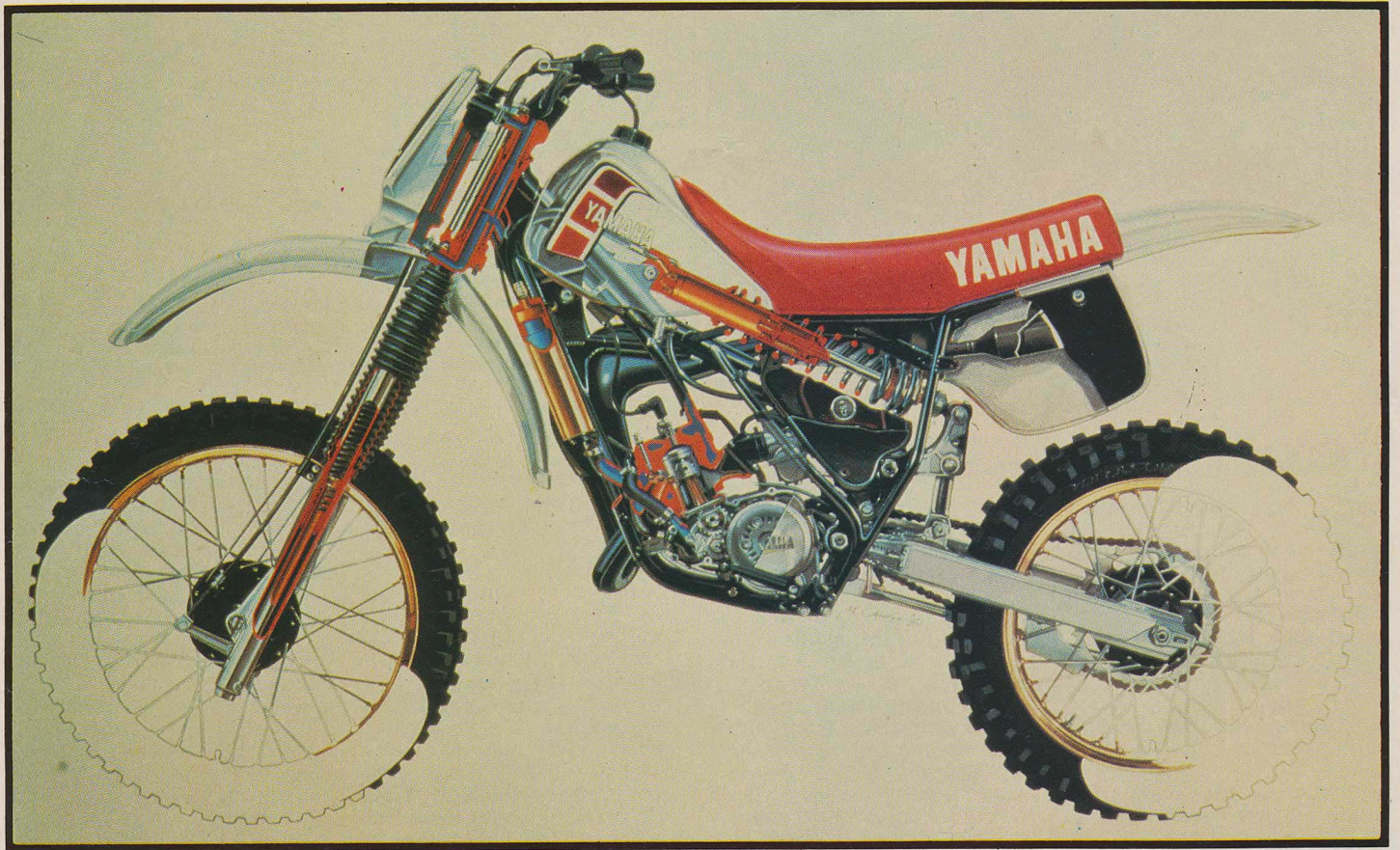


# MONOSHOCKS



## Evolution *or* Revolution?

**Single-shock suspension systems are rapidly becoming accepted as the norm for both tarmac and dirt machines, but just what is the difference between Pro-Link and Full-Floater, Uni-Trak and Link-5? Mat Oxley explains all**

**M**ONOSHOCK suspension is by no means a new aspect of motorcycle design. Although it's only in the last decade that the system has become a common feature of many machines, it was originally pioneered by George Brough back in the 1920s. Vincent were quick to adopt the single-shock system but after that the conventional twin shock design once again became the norm. That was true until Yamaha surprised everyone in 1973 by equipping their factory 250 motocrosser with a monoshock rear suspension.

Many observers considered the odd-looking system a joke

but they soon changed their minds when works rider Hakan Andersson went on to win that year's World Championship.

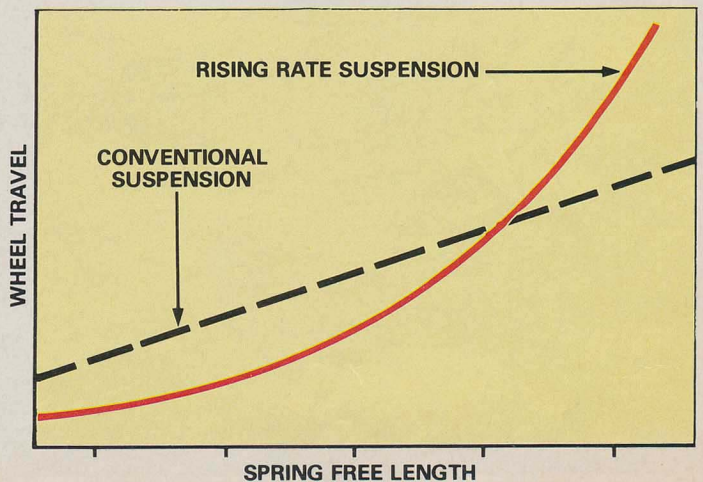
Nowadays some sort of single-shock rear end is *de rigueur* on any new machine if the marketing boys are to stand any chance of convincing Joe Public that their bike is the one to buy. Take a look at the new breed of Turbos — only Yamaha have seen fit to employ a twin shock set up on their blown 650. Kawasaki, Honda and Suzuki have all gone the single-shock route and they've also made use of the new rising-rate technology. It's rather ironic that Yamaha have ducked out on

the Turbo's suspension since they started it all. In fact it was Dutchman Lucien Tilkiens who was the first man to put together a practical monoshock system on a motocrosser.

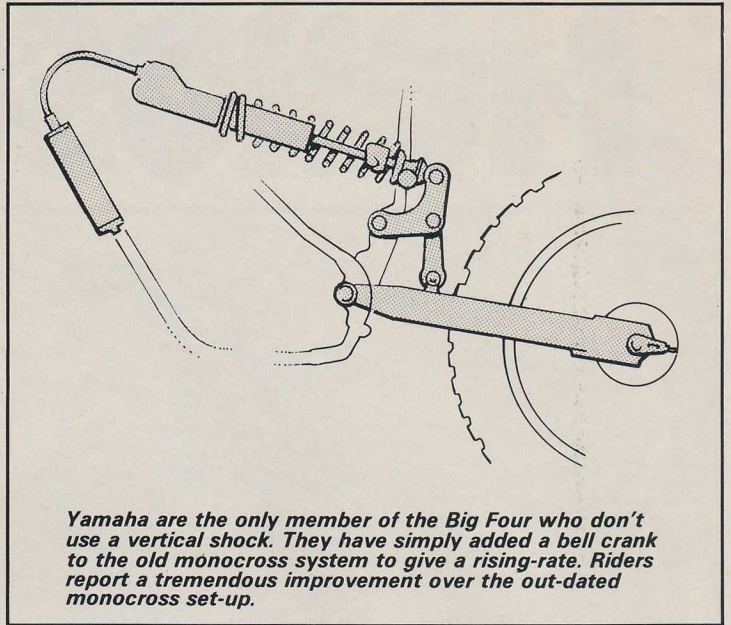
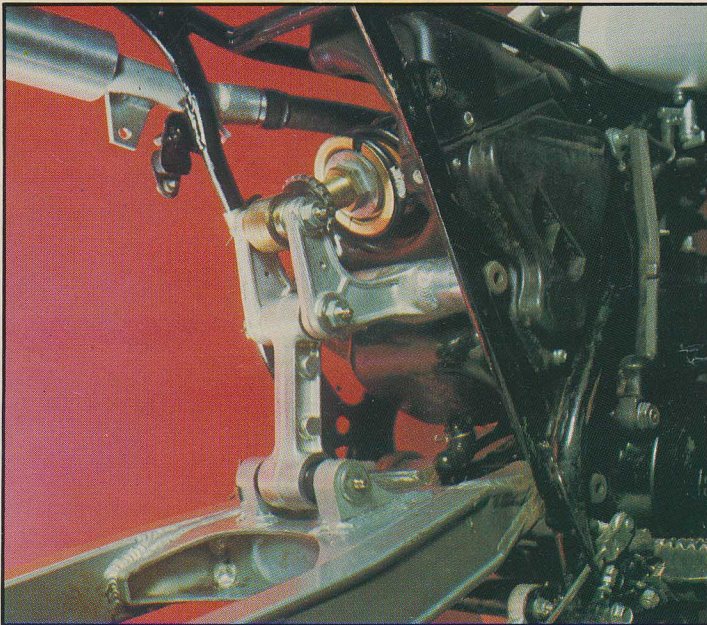
That was back in 1972 when

the Dutchman carried out tests with a home-made system. Yamaha realised the potential of Tilkiens' idea and signed him up for further development.

Since then Yamaha have applied the 'Monocross' sys-







*Yamaha are the only member of the Big Four who don't use a vertical shock. They have simply added a bell crank to the old monocross system to give a rising-rate. Riders report a tremendous improvement over the out-dated monocross set-up.*

## Evolution or Revolution?

tem to their whole range of machinery including trail bikes, road racers, enduro bikes and, most recently, their roadsters.

But despite all the hulla-baloo and ad-mens' sweet-talk, the Monocross system has no great advantage over a twin shock set up. Minor plus points like less moving parts, slightly greater suspension travel and greater protection in the event of a crash are hardly enough to make every previous suspension system redundant. What really sold the system to Yamaha was the fact that it was different and thus appealed to the buying public. And, like it or not, the motorcycle industry is ultimately all about selling bikes.

Manufacturers only invest vast amounts in competition R&D because they know that people buy bikes that win. Now time has caught up with the Monocross and new technology has dictated that the system be totally revamped.

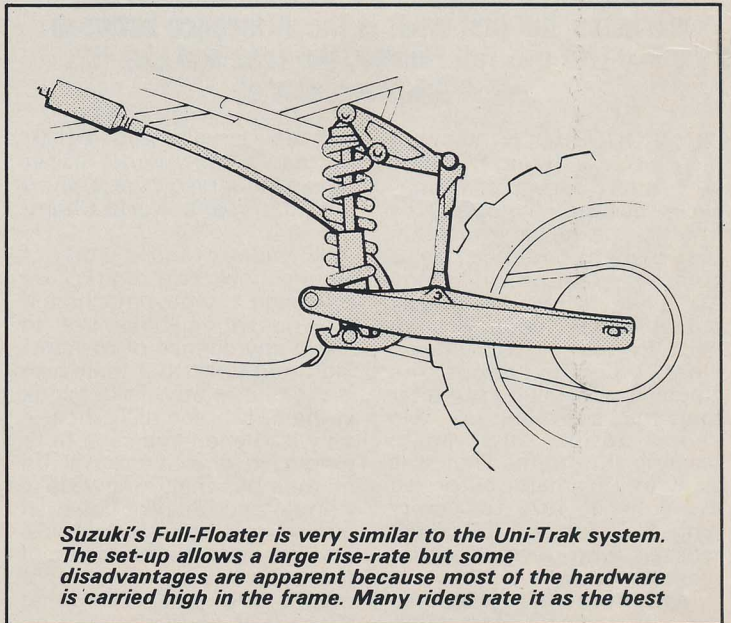
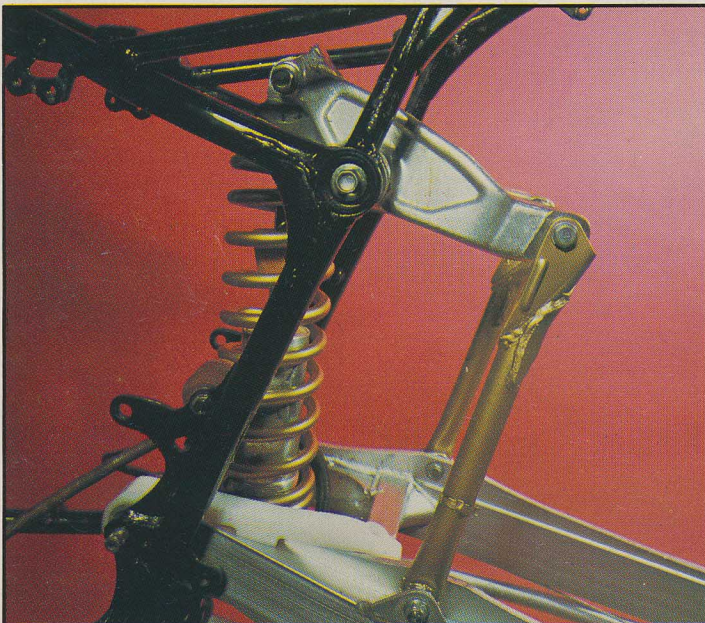
That new technology has been around for some time now but it's only in the last two years that the average motocrosser, roadracer and road rider have been able to benefit. Kawasaki were the first to experiment with a rocker-arm type suspension system. Canadian Yvon Du Hamel was the man who tested the set up but it was an initial failure. Despite that early set back, Kawasaki continued experiments and their

1975 endurance bikes, built by Godier Genoud, were equipped with a modified version of the earlier system using a Koni damper.

### UNI-TRAK

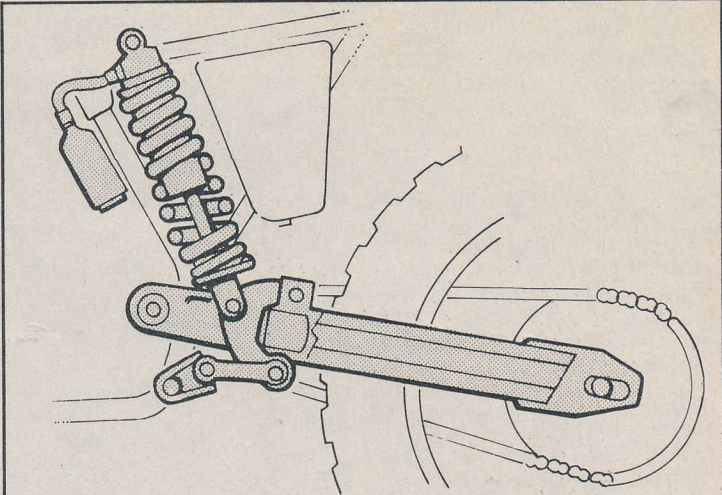
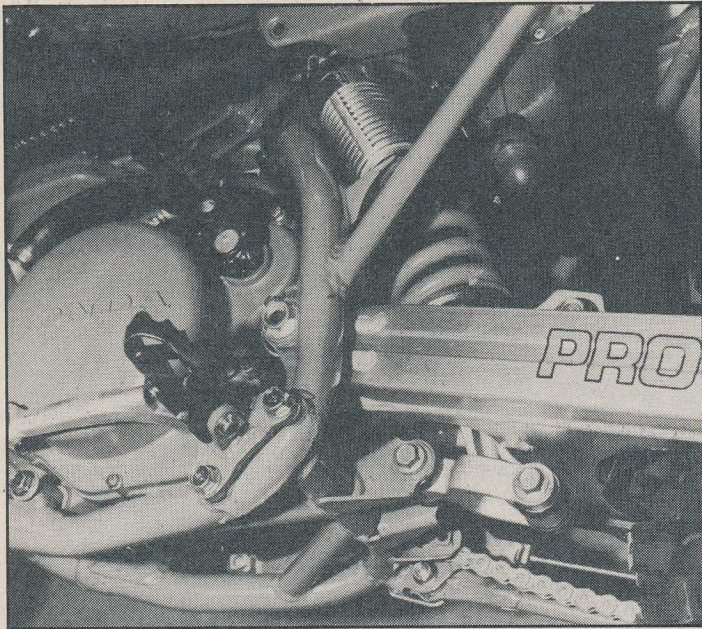
The famous in-line 250 twin was the next to receive the Uni-Trak treatment. Mick Grant rode the bike to its first GP win in 1976 and the system even then was basically very similar to the modern day Uni-Trak set up. Since then Kawasaki have won seven 250 and 350 world titles using Uni-Trak and Kork Ballington's KR500 is equipped with a similar system. Kawasaki's motocrossers didn't benefit from the new idea until 1979. That will surprise many people since it is widely believed that we owe the arrival of rising-rate suspension to motocross.

The advantages that a rising-rate system holds over conventional suspension (whether single or twin shock) are massive. Nowhere is this more true than on the dirt. A straight rate suspension system will treat small ripples and twenty foot drops just the same. Obviously this means that the motocrosser will have to make do with his suspension set in a manner that will cope reasonably well with both situations. If he sets his rear suspension on the hard side he will be able to take big jumps without the shock bottoming out and pitching him off. However, when he hits a series of small ripples at speed the hard suspension will not respond to the road surface. He'll therefore end up spending more time in the air than on the dirt. And no matter how quick a



*Suzuki's Full-Floater is very similar to the Uni-Trak system. The set-up allows a large rise-rate but some disadvantages are apparent because most of the hardware is carried high in the frame. Many riders rate it as the best*





*Honda have obviously put a lot of thought into their Pro-Link system. The bell crank is carried low thereby reducing c of g without hampering its rising-rate. Initial problems with shocks and swinging-arm strength have been solved*

machine he might have, all that power is wasted unless the rear wheel stays in contact with Mother Earth.

With the suspension set up to provide a relatively soft ride, the opposite will occur. At high speeds over uneven going the suspension will allow the back wheel to hug the dirt, but one big jump and the rider will find his machine uncontrollable since all the suspension travel will be used up. If you've ever ridden one of Honda's smaller ATCs you'll know what I mean. With no suspension their natural reaction to hitting a bump is to head skywards. Something that is bound to result in rider and machine parting company on returning to the ground.

#### **RISING-RATE**

Rising-rate suspension

miraculously provides the motocrosser with the best of both worlds. Not only will the system react as required over minor undulations, but it will also cope with big leaps. The secret to this is the system's varying leverage ratio.

When the suspension is near its full extension, the ratio is well in favour of wheel movement. That means that the wheel will have to move a large amount to use up a relatively small amount of shock travel. This will provide a soft ride for maximum grip on minor ripples. But as compression of the suspension increases under heavier going, the ratio moves towards shock movement. For the same amount of wheel travel the shock will now compress less. This effectively stiffens both damping and springing thus

providing a hard suspension at full shock compression for big jumps and leaps.

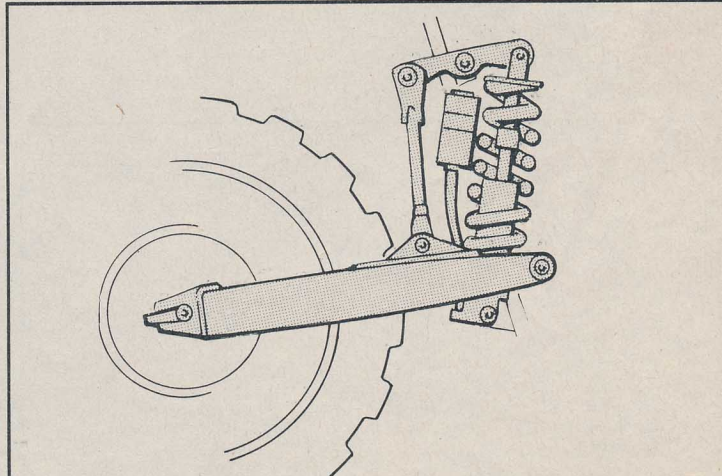
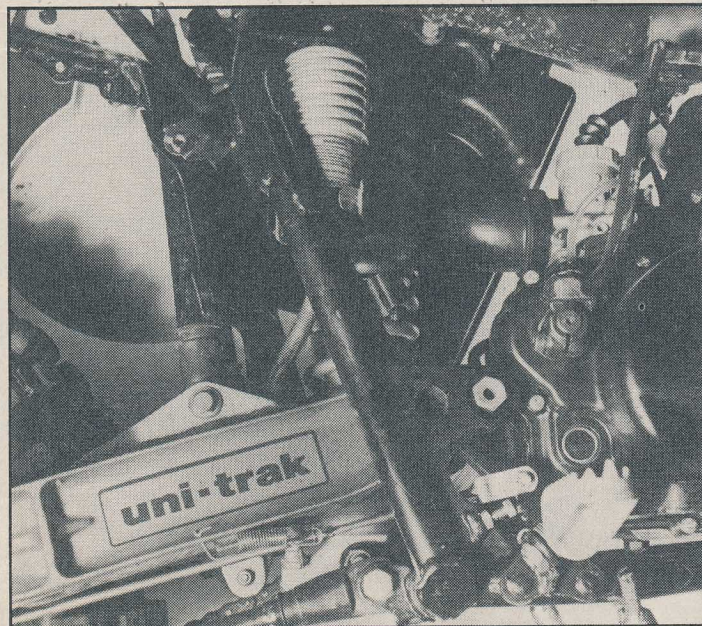
Such a system is not only of use on the dirt. Even road racers and road riders benefit from having suspension that will cope superbly with a variety of conditions. All the successful GP works teams now use some sort of rising-rate rear end and it's just about unheard of for a new motocross bike to be released from Japan without a rising-rate suspension system.

Despite that, all the Big Four use slightly different systems and hardly surprisingly they all have their own good and bad points. Kawasaki are now struggling against the opposition even though it was them that started the rush to rising-rate.

Their 1980 production bikes were, in fact, equipped with a

falling rate Uni-Trak system. This was to by-pass an American inventor's patent for the rising-rate system. So while the works bikes used the successful riser, the private buyer was palmed off with a system that gave little or no advantage over a conventional set-up. The falling rate provides the same leverage ratio at full extension but as the suspension compresses the ratio alters to allow more wheel travel for a given movement in the shocks. Thus the bigger the jump the worse the system becomes.

Thankfully Kawasaki realised the error of their ways and for 1981 they produced a straight-rate version of the Uni-Trak. Once again the system does not perform as well as a riser but that patent still stands in the way. Instead



*Although they were the first on the market with their Uni-Trak system Kawasaki have dropped behind on the motocross field because they don't use a rising-rate. The new GPZ550 and Turbo do, however, so perhaps the 'crossers will follow*



Kawasaki use a progressive spring in an effort to win back some of the works system's advantages. This version has been continued on the 1982 motocrossers but, strangely, the GPZ550 and the 750 Turbo do use rising-rate geometry in their Uni-Trak systems. The simple fact that makes the motocross system straight rate is that the shock absorber is connected to the frame and not the swinging arm as on the Suzuki Full-Floater.

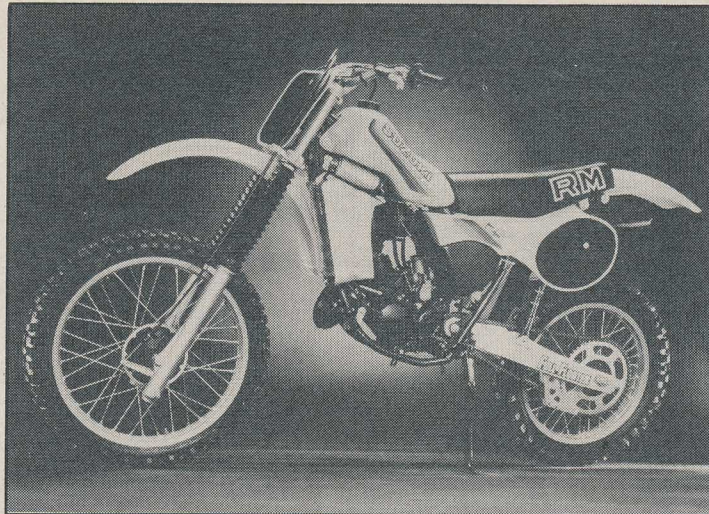
Suzuki and Honda followed Kawasaki's lead by kitting out their work's motocrossers with similar systems. Most riders believe that it is these two that provide the best in motocross suspension.

### FULL-FLOATER

The Suzuki Full-Floater appears to be very similar to Uni-Trak with the bell crank actuating on the top of the shock to transform upward wheel movement into downward compression of the suspension. The fact that the production Full-Floater offers a rising rate has got Suzuki into trouble with American inventor Don Richardson who claimed that the Full-Floater was a copy of his own design.

Suzuki now use the system on their RG500, throughout the whole motocross range and on the soon-to-be-released 650 Turbo roadster. Like the Uni-Trak, the system has adjustable damping and preload but since the design is so effective most motocrossers try to keep adjustments to a minimum to save confusion. Again, as with Kawasaki's set up, the hardware is aluminium to minimise the increase in the centre of gravity caused by the rocker arm being positioned at the top of the shock.

## Evolution or Revolution?



### PRO-LINK

Honda's Pro-Link system gets round this problem by positioning the rocker arm below the shock absorber. Although the Pro-Link doesn't provide as large a change in leverage ratio as the Full-Floater, it does provide a good ride right up until full compression when it bottoms out more rapidly than is ideally desirable. Problems of swinging-arm breakage on the 1981 production motocrossers now seem to have been overcome, and, for 1982, Honda's complete range of motocrossers and enduro bikes utilise the system.

### YAMAHA LINK-5

After being first into the single-shock race, Yamaha fell heavily behind when the competition got into rising-rate. Their Monocross system was obviously out-dated and something had to be done. What Yamaha did was very clever. Instead of jumping on the vertical-shock band-

wagon they simply developed a linkage to give their monocross system a rising rate. Dave Watson and Neil Hudson were the first riders to use the Link-5 design towards the end of 1980. Last year they used the system spasmodically but for 1982 Link-5 is a feature of virtually all the factory's motocrossers. The system has also been used with some effect by Roberts and Sheene on their GP machinery and it can only be a matter of time before we see a Link-5 equipped roadster.

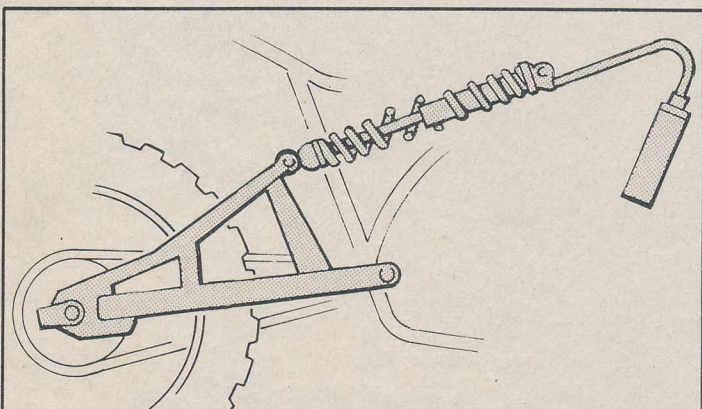
Motocross riders report a remarkable improvement over the old monocross design and at last it looks as if the average Yamaha rider will be able to compete on equal terms with the Pro-Link, Uni-Trak and Full-Floater.

The rocker-arm system benefits from many of the advantages offered by the

*Like the rest, Honda's Pro-Link is complex. There's a total of six pivots to grease and maintain*

conventional monoshock design. What is most important, however, is that most of the systems have a rising rate. This means that the need for constant adjustment for differing surface conditions is largely a thing of the past for the road rider. It also means that handling and comfort are as a result improved and unsprung mass is reduced. Of course, the new systems also have their disadvantages. The amount of pivots and links means increased maintenance of bushes and bearings. This is not a real problem for the competition rider who will disassemble the rear suspension regularly as a matter of course. But for the road rider the extra time and money spent maintaining and greasing the numerous bushes and needle roller bearings is barely matched by the superior handling offered by the better single shock systems. In addition to that accessibility to the damper is often restricted, sitting of air filter boxes is made awkward and, occasionally, an increase in wheelbase is necessary to accommodate the system.

Above all this, one factor stands out as the reason for the rise of single-shock suspension — sales. Motorcyclists love gimmicks and once the first single-shock system appeared back in 1973 everyone wanted one. That wish should almost be fulfilled in the next year or two and then, no doubt, some clever chap will come up with another piece of technowizardry to seduce us all. What that will be no one can tell. But just as we have taken suspension for granted for decades, you can be sure that riders will wonder at all the fuss the ad men have made over single-shock systems.



*Where the current trend started. In fact Yamaha's Monocross provided few advantages over twin shocks — but it looked trick*

