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motorcycle MECHANICS

PILING ON THE POWER

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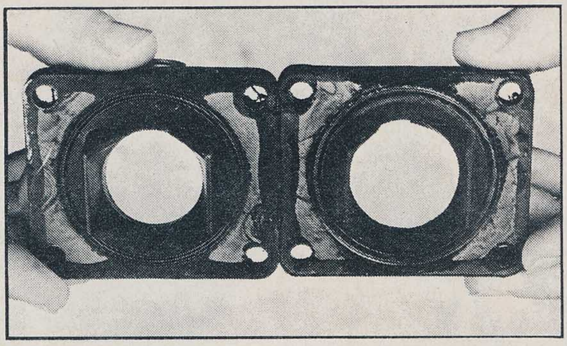
Yamaha RD250LC

Piling on the power

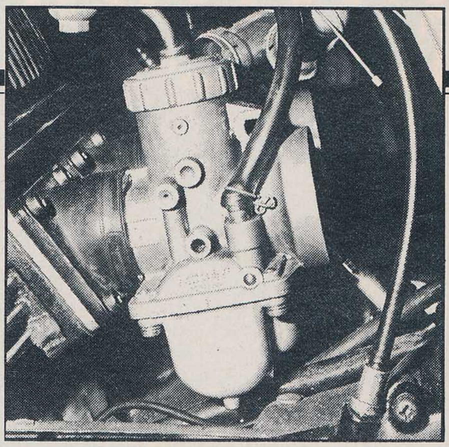
IN OUR continuing drama of the Suzuki X7 v Yamaha RD250C 250cc shoot-out series big steps have been made since the last instalment in the July 1980 issue.

Both machines have recorded best figures of 37.5bhp at the rear wheel and the Suzuki has smashed the 100mph barrier with a best speed of 105.75mph. The Yamaha has yet to be speed tested.

Brian Crichton (Suzuki) and Dave Walker (Yamaha) take up the story so far . . .



Above: . . . You can see here just how much larger the hole can be made without breaking through into fresh air.



Above right: . . . The 34mm Mikuni carbs just fitted into the standard inlet manifold. Throttle operation was "bodged" with some soft iron binding wire.

IN THE last shoot-out feature I promised you more power, but asked you not to hold your breath. It has taken some time, and a lot of effort, but the Yamaha now has 36bhp at 9,000rpm, with a good spread of urge from 7,000 upwards.

Low speed power has only suffered slightly and the bike should be quite rideable in most traffic situations.

Actually getting the bike to the above state of tune was dead easy, so easy in fact that we went looking for a lot more, putting in a lot of time and only finding out what doesn't work!

In this feature we are going to present the stages of progression in a nice orderly fashion, taking things along in logical steps to arrive at our power output. In reality we sidetracked all over the place, up blind alleys and chasing shadows, before we arrived at a point where we had yet again run out of time, rather than ideas.

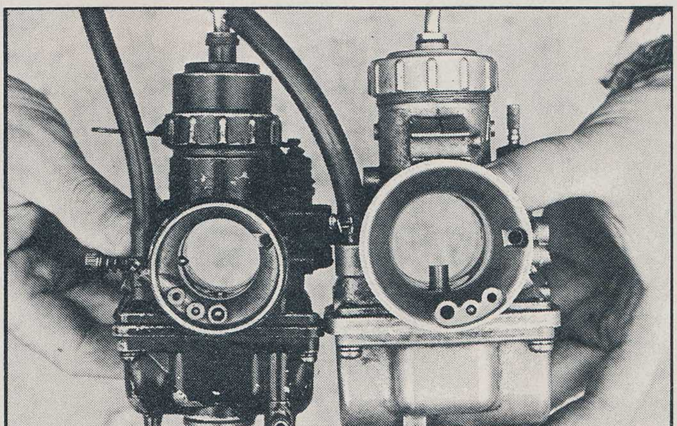
To start the ball rolling we hooked up the RD250E tapered front exhaust pipes and some LEDAR "E" chambers. After moving them around we managed to get 32bhp at 7,500 and a good spread of power from 7,000 to 8,500rpm. I then decided to fit the "Piranha" electronic ignition. This was timed up and a power curve taken. All was well so we tried altering the timing a touch either way. With the Piranha set up this is both quick and easy and we soon found that the standard setting of 2mm BTDC was about right, although retarding a fraction to 1.8mm gave a marginally higher peak, with slightly less spread. We decided to stick with 2mm for the time being.

To cut a long story short we then tried jacking up the barrels in various amounts — to advance all the port timings and altering the expansion chamber to find the best length. We finished up with the chambers at their original best setting, and a one millimetre spacer under the barrel — i.e. running with three base gaskets. Peak power had now shifted from 7,500 to 8,250rpm.

The engine still produced 32bhp but at a higher engine speed. In jacking up the barrels we had reduced the compression ratio, therefore, we had a potential power increase brought about by raising the barrel.

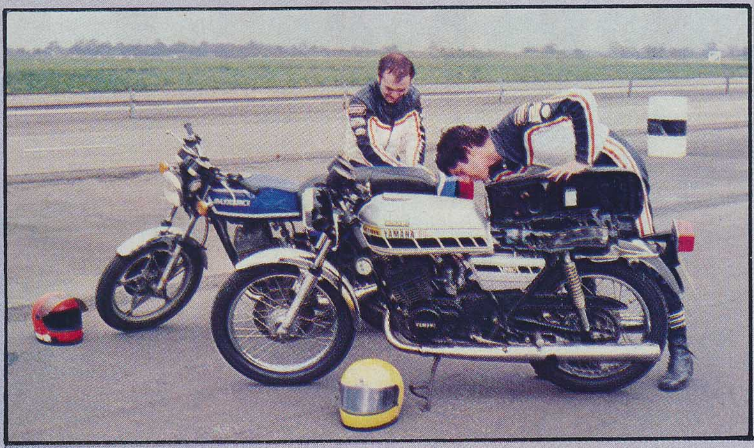
Next I wanted to attack the transfer ports. On the "C" model these have a big step at the crankcase mouth — which isn't there on the later RD250E. I opened them up and blended them into the crankcase until they looked big enough to walk through. This took a lot of time so you can imagine how I felt when we ran the motor once more and got nothing at all. Never mind. I decided to look on it as an investment for the future.

Now was the time for some drastic mods to gain a real increase and I decided to raise the exhaust port 2mm, rather than take it up in small, time consuming bites. This work was done, like the other port mods, with hand file only, following the original contour, but raising the whole thing by exactly 2mm. The result was instant success!



The bigger the hole, the better the breathing. At least that's the theory with the Mikuni TZ carb on the right.

The transfer port timing was standard and the expansion chambers were set to our previous best position, and the engine now gave 36bhp at 9,000rpm! This was really good news because the higher engine speed automaticaly gives higher speeds through the box without the need to alter gearing. Also the amount



"How much did you say those Suzukis were?"

of power lost at low engine speeds was only marginal, with the motor coming on song from a touch over 7,000 up to 9,000rpm.

The chambers were pulled around once more but the previous best position still gave the most power. This is an important point to note: altering the exhaust and transfer port timing did not alter the chamber length. But earlier, changing the inlet timing had!

What this means to the reader with an RD250 Yamaha is that if you already have a set of expansion chambers that work, you can increase the exhaust port height/timing without changing the expansion chambers. This presupposes that your chambers actually were right in the first place! You will also be pleased to know that the mixture remains just about the same — check it with the aid of a plug chop, but it shouldn't need more than fine tuning.

Having found a good increase we decided to try jacking the barrels up once more, and got the same result as before; but this time the increase in engine speed was marginal and the power slightly lower — just enough of a loss to actually measure. Raising the exhaust port was a gamble that paid off. Now it was time to guess again. We went for bigger carbs. We figured that since we could get a higher engine speed without gaining power the engine breathing was restricted — the inlet was the first place to look.

A bare Yamaha RD250 reed valve block was placed in the air flow rig, the depression adjusted to give us a constant, and the air flow noted. Next we added the inlet rubber and the standard carb. The manifold offered quite a restriction to the flow, but not as much as the carb. We squeezed a massive 34mm Mikuni into the standard inlet manifold, which helped, but wasn't the answer. The manifold now offered the largest restriction to flow.

Out came the high speed grinder and, with a rotary file, fitted the manifold was "gas flowed". This means hacked out until its shape matched the 34mm Mikuni! On the rig we were now showing a big increase in air flow for the same depression.

We had to work fairly quickly now because the carbs had only been borrowed from Bill Pentalow in Wellingborough. Bill races a Yamaha TZ750 ▶

Better biking Piling on the power

sponsored by Interstate Leathers and he was good enough to loan us two carbs, two inlet manifolds and reed valve blocks from his racer.

Having improved the breathing by a fair chunk on the flow rig we made another run on the dynomometer.

After getting the jetting somewhere near right, the maximum power output was just about the same. The chambers were pulled around but we were still stuck around the 35/36bhp mark. This was quite a blow because we were not dead sure that the reed valve block without the reeds, but with the stopper plates, would flow in the same manner as a reed valve *with* the reeds. The way to find out was to fit the TZ750 reed valve block.

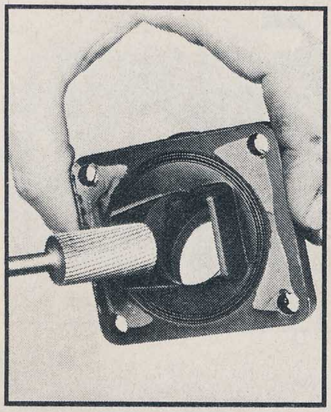
What I failed to notice, until I checked the figures in some detail at a later date, was that for the first time we had obtained a different chamber length for maximum power. Also, we were getting this around 1,200rpm lower down the speed range. However, to get maximum torque we had to use the original "best" setting, coming further down the rev range still. It now looks like the inlet timing volume or length determines the expansion chamber dimensions, rather than anything else.

The next stage was to try the TZ750 reed valves. When we ran Keith Huewen's TZ some time ago I took the liberty of measuring up his reed valve blocks with the idea of fitting some to my RD. I didn't think they would go in, but reader Joe Gardias wrote in to tell us about his tuned RD250 and he was using the TZ reed valve blocks.

Joe had machined the inlets big as they would go and made up some spacers to take the valve blocks. Although we took a slightly different route to Joe's on the other tuning mods at last we knew that the valves could be made to fit. Joe also claimed a big increase in power so the mod looked hopeful.

Cutting out the sides of the inlet port with a hand cutter took the best part of a day, plus making up the spacer blocks and gaskets etc. Fourteen hours later we were ready for the biggest increase in power to date — wrong again!

Power had shifted down the range yet again, peak torque now coming in at 7,300rpm and peak power at 8,500. It looks as though the still longer inlet



The standard inlet rubber was opened out with this rotory cutter until it matched the intake of the 34mm carb bore . . .

tract, due to the spacer/adaptor blocks, was bringing peak torque down the rev range, while the change in reed valve area/tension had moved peak power up. We also had yet another position for the chambers.

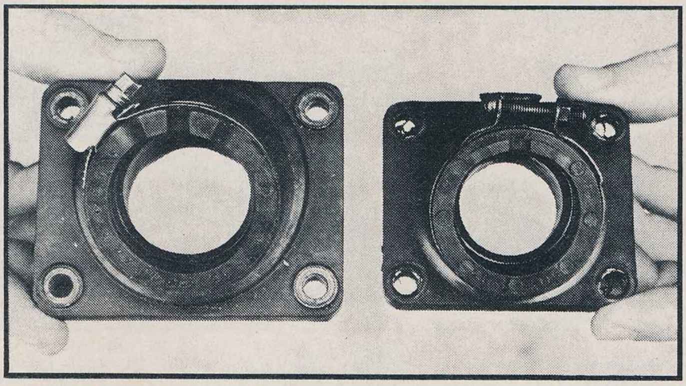
By now "team Suzuki" were waiting to get onto the Dyno so we had to call a halt. It was at this stage that someone wanted to measure the stinger pipe diameter. The silencers were pulled from the end of the chambers — NO STINGERS! We had carried out all the tests without any final tail pipe on the chambers. This wasn't as bad as it appears because the TZ750 runs without any tail pipe.

We knew that the tail pipe wasn't that important when you had got the rest of the system to the correct length — wrong again! Just to confirm this point a couple of tubes were welded onto the chambers and a very quick maximum power check made. Peak torque now shifted 1,000rpm *UP* the rev range and we had 37.3bhp! So much for theory! Just like a never ending TV soap-opera that's the story so far."

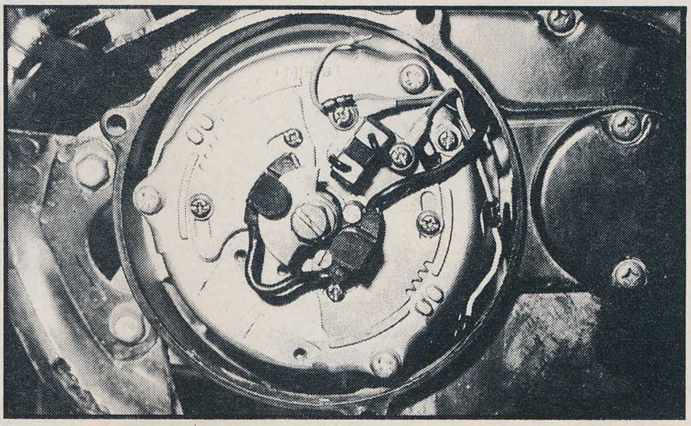
Conclusions:

This is the difficult bit. Since nobody actually knows what goes on inside an engine we can only put forward a theory based on what we have done to date.

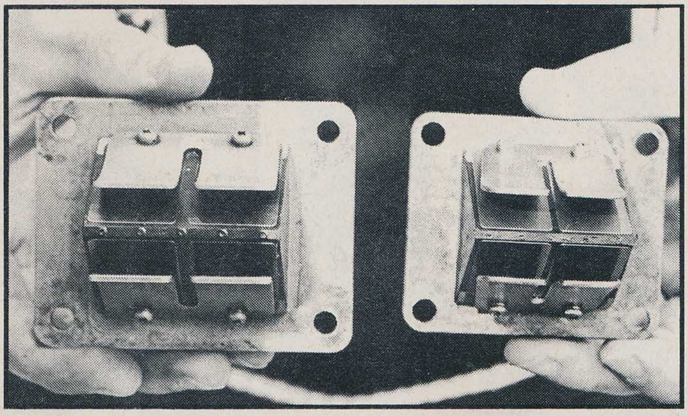
1. Raising the exhaust port does not affect the expansion chamber dimensions or length. However, we do believe that the effect of the exhaust pipe is increased due to opening the cylinder port earlier. This means that the pressure/sound wave moving out into the pipe



The TZ750 inlet manifold on the left offends the flow rig to a lesser degree, but combined with the larger carb it gave no extra power.



The Piranha electronic ignition ensures accurate spark timing at high engine speeds — and it doesn't need constant checking or adjusting.

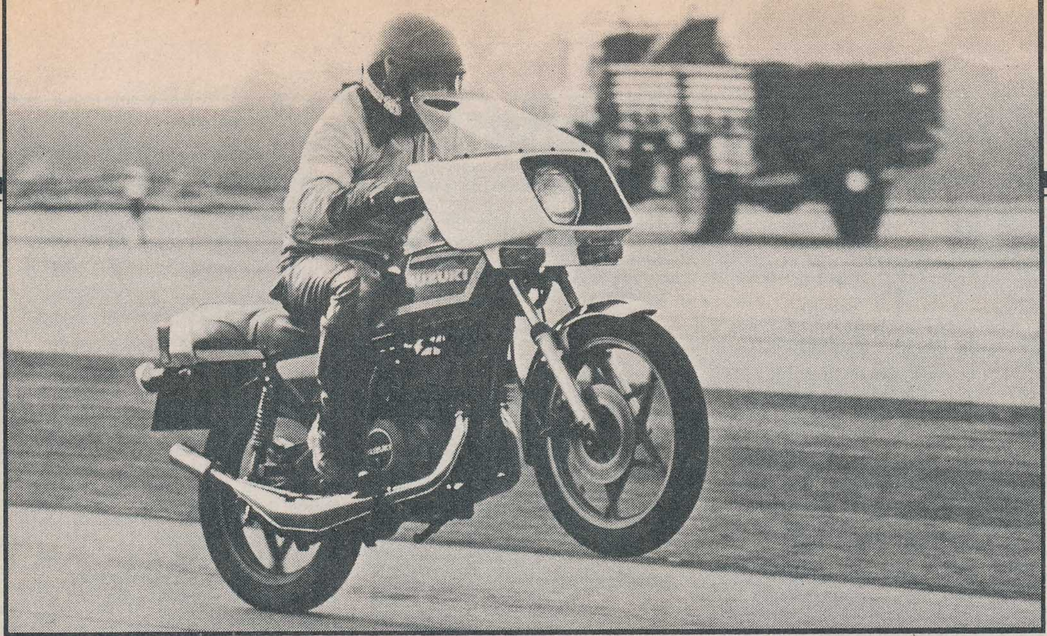


The TZ reed valve block on the left has a much larger area, but the valves have a different spring rate making direct comparison impossible.

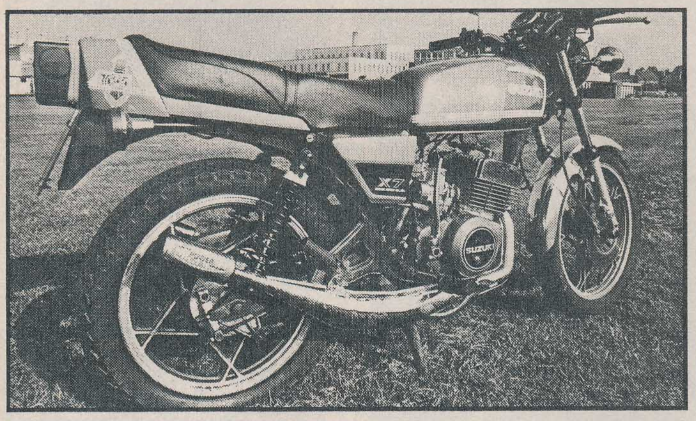
is of a higher value because the combustion pressure is higher when the piston is closer to TDC. Following this theory an increase in compression ratio should have a similar effect to increasing the exhaust port height — but probably to an even greater extent.

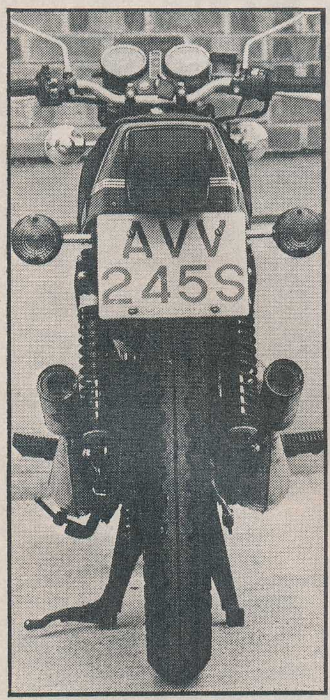
2. Increasing the overall port timing does move peak torque further up the rev range although maximum rpm was hardly effected. This means that the power band is made narrower.

3. Any alteration to inlet port timing, length shape or volume will change the expansion chamber dimensions. At the

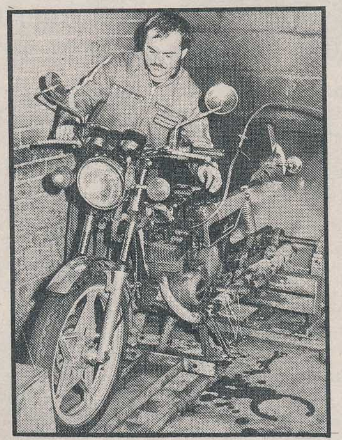


As well as being a shoot-out bike the company Suzuki gets used for other tests such as the fairing article in the June issue.





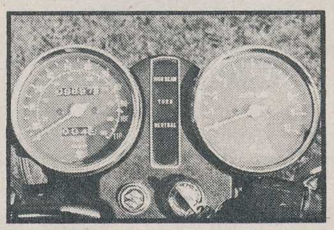
The S&W rear shocks have made the rear so tall that the back tyre touches the ground on the mainstand.



Work on the dynamometer earlier in the series provides the proof of the tuning pudding.

S&W Stroker shocks have raised the rear. The standard units had pitted rods.

start of this shoot-out feature we fitted a simple balance pipe to the inlet rubber and achieved an increase in mid-range power. It now looks like the exhaust system "saw" this mod as a straight forward increase in inlet port volume/length.



The speedo goes to 115mph, but it's not enough for the Suzuki needle which now goes straight off this optimistic unit.

Increasing the length/volume of the inlet tract moves peak power and torque down the rev range — once the exhaust has been altered to match it.

4. The effect of the stinger addition was to counter the longer inlet tract length/volume change by bringing peak power/torque back up the rev range — but over a very narrow power band.

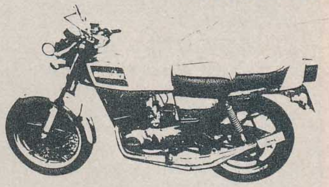
In case you missed it the best current state of tune is as follows: No air filters with RD400 inlet manifolds. Opened out transfer ports, matched to crankcase. Inlet port timing to 180 degrees. Exhaust port raised 2mm, i.e., 27.5mm from the top of the cylinder bore. "Standard" RD250E expansion chambers with the RD250E tapered front exhaust pipes. This gives 36bhp 9,000rpm, with a fair spread of power from 7,000

When opening up the exhaust port you must put a small radius back onto the top of the port. Failure to do this results in broken piston rings and a damaged piston/cylinder bore.

Finally a word about jet sizes. I gave my main jet sizes as being 140 for running without air filters. These jets were supplied by a road racing friend who does all his development with a set of millimetre graded main jets. The 140 jets I used bear no relationship with the "Amal" type grading number.

The Amal number relates to cc per minute for a given pressure with a specific fuel. Amal were kind enough to check out my "140" mains on a special flow rig and these were rated at 210s. This is the size you should be running with Amal type main jets.

Dave Walker



Suzuki X7

THE SUZUKI now looks good for 110mph. When we first started the shoot-out series in the May issue this year my secret hope was for this speed. The sensational 105.75mph obtained recently at MIRA on standard gearing and with no streamlining now makes it seem possible.

The Suzuki broke through the 100mph barrier thanks to tuning modifications carried out by Paul Slater, the man behind Micron exhausts in Alfreton, Derbyshire.

Before the bike was delivered to him the best figures obtained so far had been 98.84mph top speed, 14.27sec/90.19mph standing quarter and 30.5bhp at the back wheel on the LEDAR dyno.

Paul spent a week and a half on the engine. He raised the exhaust port 2.5mm, widened it, opened up the transfer ports and matched the ports to the crankcase.

A new crank and oil seals were inserted and the head skimmed so that each combustion chamber had a capacity of 9.5cc. New pistons, rings and small ends were inserted.

The inlet was not touched nor the pistons. Paul argues that altering the inlet would not match up with the exhaust dimensions. All ports were radiused to prevent the rings snagging.

The ignition timing was retarded two degrees because of the increased compression (normally 6.7) which Paul has calculated at 7.5. Four star fuel is now being used instead of two star.

Putting great store by increasing the transfer area the port now closes 65 deg ABDC

Piling on the power

and the exhaust closes 95 deg ABDC.

The standard 26mm Mikuni carburetters were retained with 105 main jets, the needle on the middle position and K&N air filters fitted.

With 9750 miles on the clock the Suzuki had worn through its second tyre. So a new 4.10 x 18 Dunlop TT100 K81 was fitted before speed testing.

An increase in power at higher revs was immediately noticeable. Trouble was the clutch was not able to hold the sudden jump in power when the rev counter showed 7200rpm.

The speedo was well off the 110mph clock when it rocketed through the trap at MIRA with 105.75mph recorded. The rev counter was showing 9400rpm. It was past the power peak and crying out out for higher overall gearing.

Standing quarters were out of the question because of worsening clutch slip. The machine, now quite noisy because of the dramatic increase in induction noise and harsher exhaust note due to the tuning, was cruised back to the *MCM* workshop.

Extra clutch plates were purchased but there was not quite enough room to squeeze in an extra cork and steel plate. As a temporary measure ¾ inch washers were hand-filed to enlarge the centres so that they could be used to pack the clutch springs for extra pressure

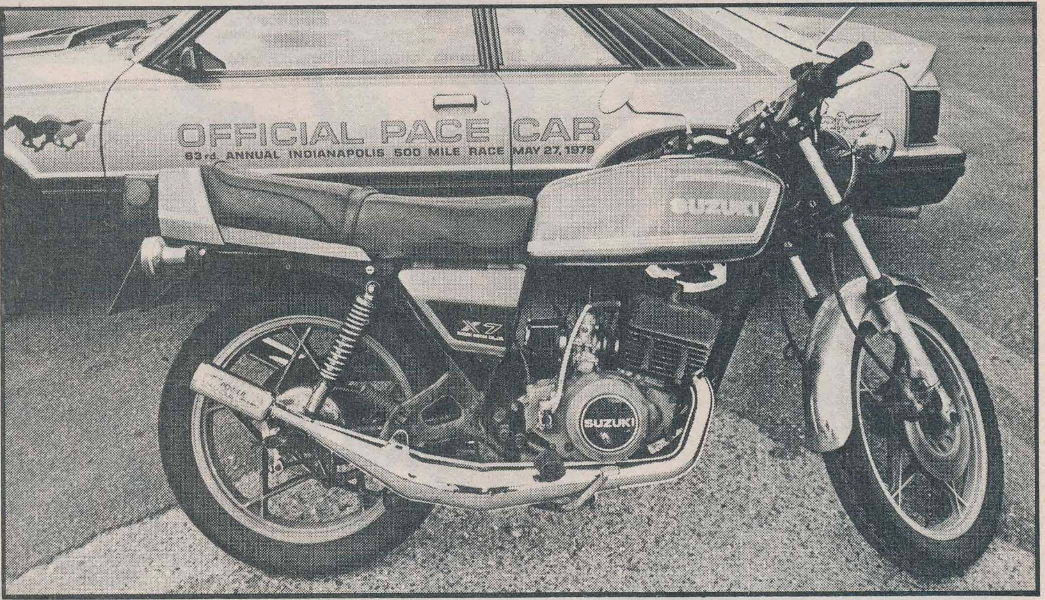
One washer per spring was inserted and this did the trick ready for the machine to be run on the LEDAR dyno.

The increase in power was better than we had anticipated. A best figure of 36bhp at 8500rpm was recorded — Fantastic.

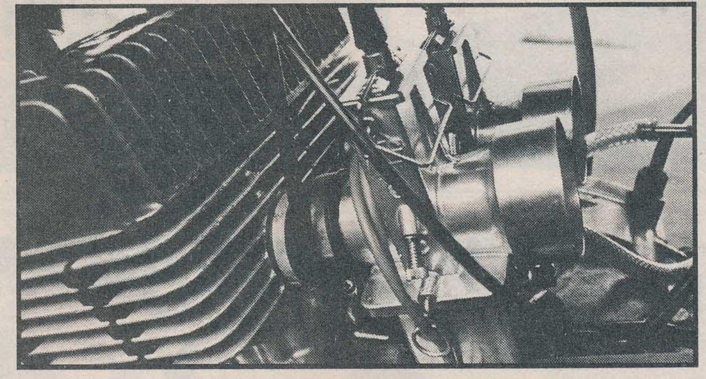
It now seemed likely that bigger carburetters would be of further benefit. In the June issue we had tried 28mm Mikunis from a GT250 Suzuki when the engine was giving 30.5bhp. This proved unsuccessful with power dropping to 28.7bhp.

Now that the engine was giving a 20 per cent power increase it was time for a second try. This time we chose 30mm American El units supplied by importers M R Holland.

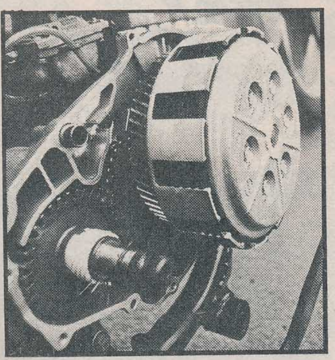
Each carburetter comes with three needles each with three adjustment points. The units were set with the middle needles on the middle positions.



An official pace car and the shoot-out pace bike. The Suzuki still has the edge.



American 30mm El carburetters have givn a power boost. Currently the bike gives 37.5bhp. A standard model gives 28.5bhp.



There was not quite enough room in the clutch for an extra cork and pressure plate.

There was a problem in fitting the left carb. Much bigger than the Mikuni it rested on the engine casing. The instructions expressly state that this should not be allowed but we thought we would try it anyway.

The Els helped to smooth the power at lower revs with a slight increase in power. The best figure obtained was 37.5bhp at 8800 revs and so it seemed a worthwhile exercise to leave them on.

On the road, the mid-range definitely felt to be improved from what has inevitably become a peaky and very exciting engine. But to get the carbs to run smoothly the weakest needle on the weakest position had to be inserted in the left carb only.

We are still experimenting with settings and may have further news to report in the next issue.

At this stage I propose to call a halt to work on the engine and move on to streamlining and cycle part improvement. Paul Slater had already expressed concern over the delicate nature of the Suzuki crank. We would rather have a reliable runner than an overtuned temperamental shooter anyway.

S&W freon gas shocks have already been fitted. They had to be inverted to clear the chain guard. Even so the left unit's 90lb spring still touches the guard even though it has been packed with washers supplied with the units, again from M R Holland.

These are a vast improvement on the standard units which were pitted and losing oil. The S&Ws also give higher ground clearance.

On the negative side this has placed more weight on the front and reduced the trail. Not such a good thing on a bike which already displays rather nervous handling tendencies. Air forks may be the answer.

Meanwhile the X7 with its high back end and more powerful engine is beginning to look and become leaner and meaner.

Brian Crichton

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Engine tuning: **price on application from Paul Slater, Codnor Light Fabrications, Birchwood Way, Cotes Park, West Industrial Estate, Somercotes, Alfreton, Derbys. Tel: 077383 6133.**
Micron exhausts: **£98.61. Free fitting service offered at above address, also details of all stockists.**
El carburetters: **£66.47 each. Details of your nearest stockist from M R Holland (Distributors) Ltd, Unit 2, Benner Road, Wardentree Lane Industrial Estate, Spalding, Lincs. Tel: 0775 4831.**
S&W Freon Gas Cell Shocks: **with springs: £79.58 per pair. As above.**