

Above Despite the magnesium engine covers, the MX400B was overweight, but this was compensated for by the gutsiest engine on the block

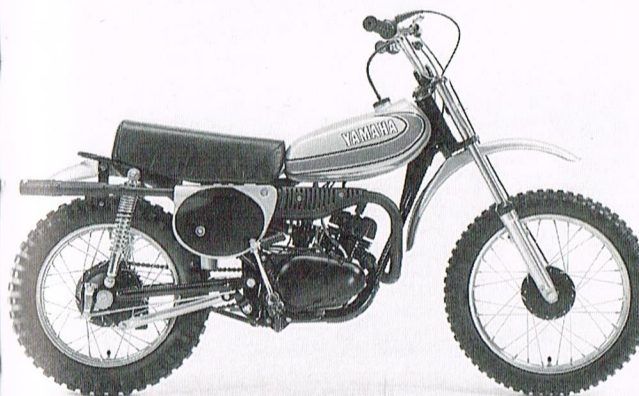
trouble although at 100 kg it was also a little overweight. Rear brake on both machines needed to bed in before a measure of sensitivity was achieved, a carry-over from the bad old original MX machines. On the 400, pistons started cracking after only a few hundred miles of use. This was caused by a combination of too wide inlet and boost port on the rear cylinder wall and the square cutaway on the inlet side of the piston skirt.

The MX250 and 400B models were the last of their type in these two classes. Effectively, 1975 was the last year of the MXs; another 125 model appeared in 1976 and the 175 was resurrected at the end of the 1970s. The works machines had provided the publicity for Yamaha, the MXs had provided the introduction for many riders, and it was left to the YZ series to build on this foundation and put Yamaha at the top of the motocross tree.



Above In Europe, Ake Jonsson was provided with this YZ400 for 1975, but it was an uneasy relationship and fourth place in the world championships was the result

5 The path to excellence



The YZ80 first appeared in 1974, but it was to take Yamaha a couple of models before it arrived at the top of the class

By the start of 1976, all four Japanese companies were locked in battle for the motocross manufacturers' crown, in all of the three main classes. Kawasaki was lagging behind the other three a little despite Jim Weinart's US 500 class crown in 1974 and Olle Pettersson's earlier efforts on the racetracks of Europe. Honda had concentrated on the US and thumbed their noses at those that had labelled them as incapable of making a competitive two-stroke, by producing the Elsinore series. Success was achieved at both national and local level. For 1973, Gary Jones was bought in, after two seasons as National 250 champion with Yamaha. A clear winner in 1973, Gary was pushed hard by Marty Tripes riding Husqvarna in 1974, but still took the title for the fourth consecutive year. In the first 125 series held in 1974, Marty Smith ran away with the championship for Honda and repeated the performance for 1975. For 1973 and 1974, the 125 and 250 Elsinores were virtually unbeatable at local level, but by 1975 Suzuki and Yamaha machines were getting the edge over the Hondas. Motocross competition in the US was about to enter the era of Yamaha's total domination of the 125 and Supercross classes and a see-saw battle in the 250 and 500 class between the factory and one of the other Japanese manufacturers. Glorious days for the company.

The 1976 line-up consisted of six YZ models—80, 100, 125, 175, 250 and 400. The 80 cc class was fast becoming the most oversubscribed class

in the US for the under-14s dreaming of bigger and better things in the future. Yamaha had produced the first YZ80A back in 1974 and it had been a competent machine putting out 7 bhp at 9000 rpm. The conventional piston-port engine was equipped with Autolube lubrication and was slotted in a duplex cradle frame with conventional dual-shock rear suspension. Unfortunately the Honda XR75 was quicker than the Yamaha and typically the US concern put out a comprehensive Genuine Yamaha Tuning (GYT) kit consisting of a new pipe, cylinder, head, piston, carburettor and main bearing that raised the output to a Honda-beating 10 bhp. For 1975, the GYT parts were incorporated into the stock machines and little else changed. For 1976, the suspension travel was increased at both ends, the front with longer stanchions, the rear with laid-down shocks increasing the arc of the rear wheel. The use of reed valves improved the low end of the engine enormously while the 24 mm carburettor and new cylinder porting helped push the output of the little machine to 12 bhp at 9000 rpm. The YZ80C was the fastest stock machine in its class.

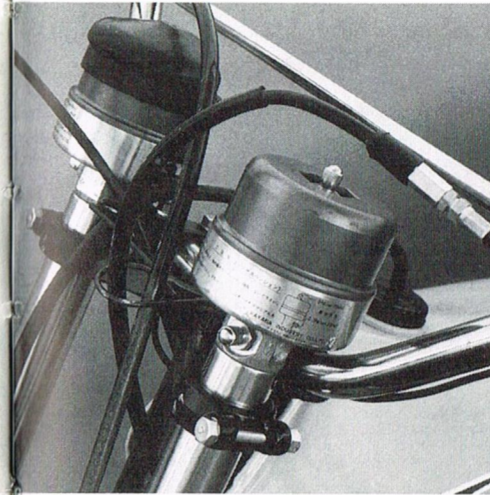
The YZ100C and 125X (the X was used to get the model designations in line) were essentially the same bike. Apart from the obvious differences due to capacity, it was only the front suspension that distinguished the two. The 100 used conventional coil spring front suspension. The 125, 250 and 400 were all fitted with new front forks in which compressed air was used to cushion the rider.

Air has always been a tempting medium for fork designers due to its and any gas's progressively increasing resistance to compression. Unfortunately, the simple application of compressed air to provide the front fork cushion, resulted in either too little cushioning during the initial fork compression or too great a resistance to movement over the last part of the fork compression. Yamaha came up with a solution to the problem. An aluminium cannister was screwed

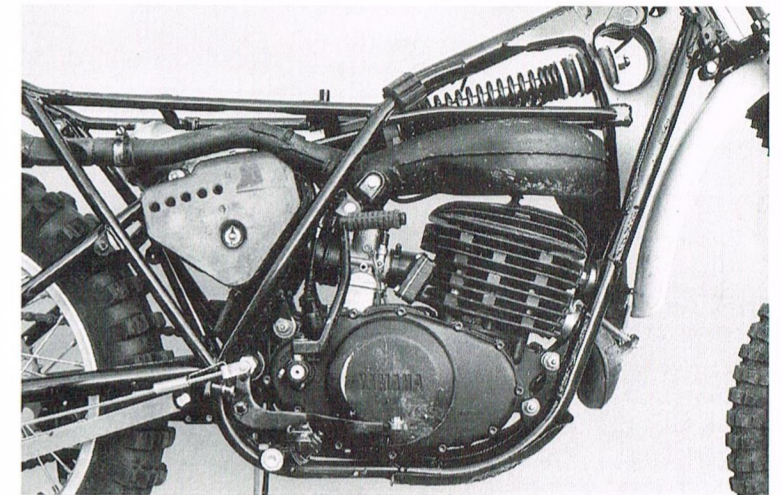
to the top of each fork leg. On the top and bottom of the cannister were two separate air valves that controlled the pressure above and below a floating piston that was located inside. Conventional Ceriani-type dampers were attached to the bottom of the stanchions.

There were therefore three adjustments that could be made to the forks, oil level, air pressure above the floating piston and air pressure below, which effectively meant within the stanchion. The air pressure under the piston regulated the initial movement of the fork, in much the same way as spring preload. The pressure above the piston was set to approximately double the stanchion pressure in order to define a point at which the floating piston would move and ease the stanchion pressure, much like a safety valve. A change of oil level would result in a change in compression ratio between the air and oil in the fork, similar to changing the spring rate of the fork. With the nitrogen-charged monoshock on the rear and air forks up front, the new Yamahas had infinitely adjustable suspension, in theory at least.

A few changes had been made to the excellent, if disappointingly poor-selling, YX125C of 1975. Inevitably the ports had been breathed on, with narrower, higher transfers intended to broaden the powerband a little. A change across the board for the YZs was the rounding of the cutaway on the inlet side of the piston skirts. The MX and YZ models of 1975 had suffered from drastically reduced piston life, due partially to cracking at the corners of the square cutaway. Carburettor diameter grew 4 mm to 34 mm and the CDI unit had an internal pulse generator for triggering the spark. The primary gearing was changed slightly to allow the use of a larger $\frac{5}{8}$ in. pitch chain after it was found that the correct drive sprocket would foul the cases with the new chain. The rear swinging-arm was lengthened 30 mm, the longer wheelbase improving straight-line stability. Some work was done on the monoshock unit to increase rear wheel travel



Air was used to suspend the 125, 250 and 400 motocross machines in 1976 and these aluminium cannisters provided infinite tuning capabilities



Although appearing to differ little from the MX400B engine, the YZ400C had been updated to improve reliability

to 200 mm with less spring preload.

Both the 100 and 125 worked well on the track, once some attention had been paid to the rear suspension. As delivered it was too stiff, resulting in a very harsh ride. A softer spring eased the problem considerably. With 18 bhp on tap, the 100 was a lot more powerful than its only significant competitor, the Suzuki. But the Suzuki's suspension was better and steering more precise making the two a pretty even match. The same was true with the 125. With almost identical top end, it was the greater mid-range power that gave the YZ the advantage over the RM, but it was really close. The suspension and steering on both machines was very good making the two almost inseparable, except for the \$35 higher price of the YZ. Machine performance wouldn't be able to make the one a best seller over the other; that would have to be left to the advertising people.

Development of the 250 model was carefully restricted to correcting the deficiencies of the 1975 model. The engine was left largely

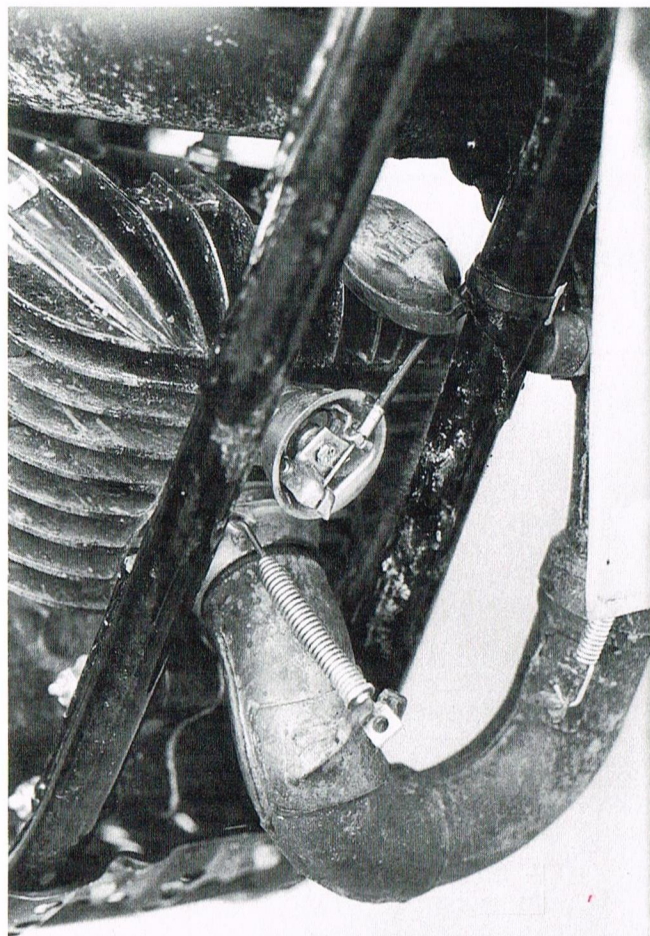
untouched except for a new exhaust which flattened out the powerband a little and straight-cut primary gearing for maximum mechanical efficiency. Two extra bolts were used to secure the cylinder and head of both the 250 and 400 machines. Most changes were made to the chassis with new air forks, a tubular section upper fork on the swinging-arm, plastic drive chain tensioner, caged needle roller bearings for the lower swinging-arm pivot and what would appear to have been thicker mild-steel frame tubes. Apart from the slightly longer wheelbase caused by the longer forks, frame geometry remained identical, but the weight of the machine increased by 9 kg. This could only be accounted for by a sturdier frame which would correspond with some reports of broken frames in 1975.

Whereas little changed on the 250, little remained of the MX400B in the YZ400C engine. Additional piston support was provided not only by the redesigned inlet skirts found on all the C models, but also by a bridge in the rear cylinder wall between the boost port and the inlet port.

This was a direct reaction to the MX400B problems experienced by desert racers, who were forced to replace pistons after every race to maintain reliability. Detonation and seizures had also occurred on the old 400, and Yamaha's reaction to the seizure problem was to move to a two-ring piston. Their expectation was that the two rings would provide a better gas seal and reduce the chance of blow-by passing the rings, heating the piston wall and breaking down the oil film between the piston and cylinder wall. The factory tackled the detonation problem by replacing the CDI system and modifying the 38 mm carburettor needle jet so that it, and the main jet housed within it, were held at a lower position in the float bowl, resulting in reduced surges in fuel delivery when running over rough terrain. The clutch and transmission were unchanged in design, although stronger gears were used in the gearbox. The chassis was common to that of the 250.

Both 250 and 400 proved to be very good machines, the front suspension now matching the efficiency of the monoshock. Even the most difficult terrain was soaked up efficiently by the new set-up. The chassis changes combined with the less pipey engine power made the 250C easier to ride than its predecessor, the main criticism, except for the inevitable rear brake, being the slowness with which it steered through corners, a typical Yamaha trait of the time. The excess weight also made itself felt on both machines when the rider was negotiating tight turns. The 400 baulked at clutchless gearchanges so important in close racing, a criticism that had been made of the YZ125 before. Aside from these comparatively minor criticisms, the YZ250C and 400C functioned well and were as good, if not better than the Japanese competition.

There couldn't have been a sharper contrast between the official factory efforts in Europe and the US. For 1976, Yamaha had withdrawn from the world championship competition to get a



The compression-release mechanism that had been provided since the 1973 MX360 was still present on the YZ400C

team properly organized after the increasing shambles of 1974 and 1975. In the US, Pete Schick, Yamaha's motocross team manager, signed up a batch of promising youngsters to form what was to be the kernel of the team for the next four years. You can say one thing for Schick, he certainly knew talent when he saw it. Signed for 1976 were Bob Hannah in the 125 class and Rick Burgett in the 250. Hannah was



After four years of production, the 1976 Open Class YZ400 was reaching towards the title of class champion

stolen from under Suzuki's nose as they hesitated to sign him up for a crack at the National title after a few months riding for them in southern California.

Hannah immediately showed how ready he was for National competition by winning the five-race Florida winter series for Yamaha. For the 1976 attempt on the 125 title, Yamaha gave Hannah all they had in the form of a water-cooled

factory machine that had been used in 1975 in the Japanese championships, the OW27. A small radiator was located behind a wire gauze front number plate nestling between the front forks. A water pump was located in the space vacated by the Autolube equipment and drove the coolant to the heavily finned cylinder and head. Output was judged to be around 23 bhp at 10,500 rpm. With mechanic Bill Buchka, who seems to have been the man behind so many US and World champions, to look after the factory machine, Hannah easily defeated reigning champion Marty Smith for his and Yamaha's first 125 title. The only panic of the season came when a disgruntled privateer invoked the AMA's infamous claiming rule to gain possession of the machine for \$2000. Hannah immediately issued a counter claim and had the luck to be picked out of the hat! Yamaha got such a fright that the machine was rushed out of the country, to be replaced by the 1975 US factory machines which Hannah was able to win on equally well. Burgett had a less successful year than Hannah, finishing 7th, two points behind his team-mate who had also come out in a few 250 races.

The same 5 models were available in 1977 as the D series. The C series had been a success in terms of both sales and results, so it must have been tempting for the factory to allow the models to mark time for a year. With one exception, the YZ machines were updated for the new model year, the factory realizing that in the fantastic pace of development in which the motocross world found itself, the best machines of one year can easily be the worst of the year following. The competition, primarily between the three Japanese companies, was fierce.

The YZ80C had been the undisputed king of the egg-cup racers in 1976, the four-stroke XR75 of Honda finally well and truly beaten. No complacency from Yamaha; word was out that a new RM from Suzuki would appear in 1977. New carburation involved the next size Mikuni at 26 mm. Wider ports could be found in the new



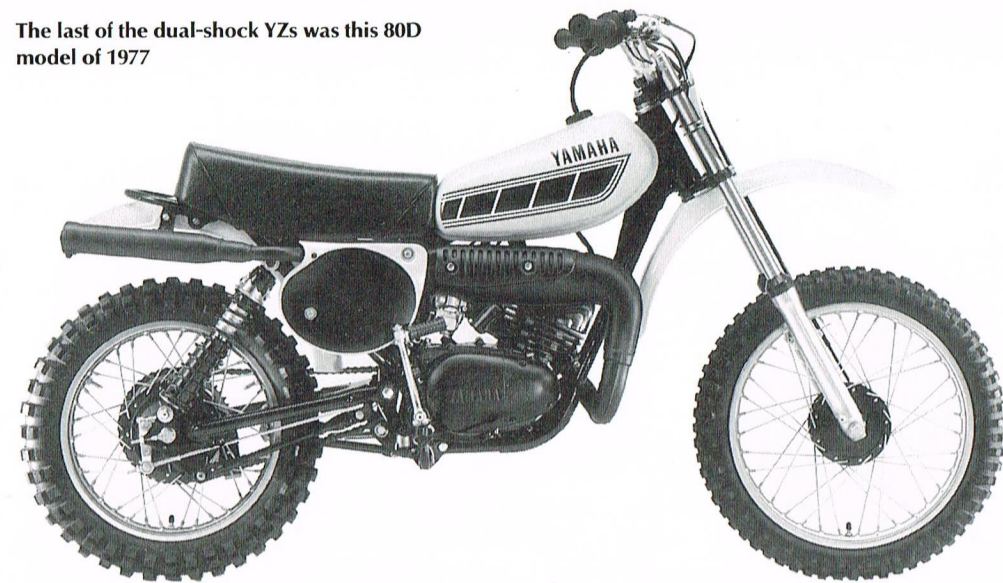
Yamaha's first water-cooled YZ125 was run in the US during 1976, until a close-call with the infamous AMA claiming rule caused Yamaha to restrict its use to Europe

cylinder. The transfers and intake grew 2 mm, while the exhaust came out 1 mm wider and 0.5 mm higher. The engine modifications added a single bhp to the bike's output bringing it up to 13 bhp at 9500 rpm. The chassis was not forgotten, 25 mm extra wheel travel was found at the front and 13 mm at the rear. A slight change in steering geometry, reducing the rake and trail helped quicken the steering of the bike. Out on the track it had the edge over the Suzuki, but it was only an edge. The YZ had a wider powerband and better front suspension, the RM turned more easily and soaked the bumps at the rear end better. Probably the \$36 price advantage of the YZ was all it needed to outsell the RM.

Nothing changed on the 100 model, except the use of the new transmission of the YZ125D and the paint job. Hopped-up RMs had given the YZ a hard time in 1976, but the company didn't have the time or resources to spend on the 100 and the class was handed to Suzuki for safekeeping for a year. A new model appeared to keep face but it was just not competitive with the RM100B.

The 125 was once again a monoshock reed-valve six-speed single, but that's where the similarity with the YX125X stopped. The bike had undergone a major redesign during the winter of 1976 to produce what was considered by everyone to be a Hannah replica. Engine cases were cast with water passages at the base of the cylinder, an indication of the way Yamaha were pushing the development. The right-hand crankcase sidecover was magnesium alloy, whereas plastic was used to cover the CDI magneto and drive sprocket on the left-hand side of the machine. The separate head-to-cylinder and cylinder-to-crankcase fastening technique was lifted from the larger MX machines, to prevent any cylinder distortion or head warp caused by the different expansion rate of the aluminium muff and the steel fastening bolts. Inlet and exhaust ports were narrowed slightly to flatten out the powerband while the compression ratio was raised a fraction to 7.8:1. Lighter full-circle flywheels were found in the crankshaft, as Yamaha raised the engine speed for peak power by 500 rpm. The new con-rod had large slots milled in the big-end eye to improve the bearing lubrication. The piston was

The last of the dual-shock YZs was this 80D model of 1977



two models old, dating back to the YZ125C. The carburettor throat diameter came back a size to 32 mm which was considered more suitable to the new power characteristics than the old 34 mm Mikuni. With the carburettor offset slightly to the left of the bike it was possible, due to the revised frame design, to incorporate a single air filter box, replacing the double unit that had occasionally broken on earlier models.

Primary transmission was still via helically cut gears, the power loss this incurred probably being imperceptible, but the noise reduction not. Three less teeth on the transmission gear raised the gearing slightly. An extra pair of plates was added to the clutch and the clutch-release push-rod was actually bolted to the outer pressure plate instead of butting up against it. The gearing throughout the gearbox was higher than had been found on the X model. The engaging dogs on the gears were also undercut less to help shifting under power, something earlier 125s had not excelled in.

Complementing the engine changes was the first upgrade to the chassis since the introduction of the monoshock suspension. As always con-

structed in mild-steel, the main feature of the new chassis was the frame employing an enormous pressed-steel backbone member extending from the headstock to the rear subframe. A single front downtube extended down to a point just above the exhaust manifold. Here a dual-rail cradle started and looped down under the engine up to the rear subframe. Cross-bracing for the cradle could be found under and behind the engine and bracing with the central backbone above and behind the engine. Really massive gusseting was present at the backbone/headstock joint.

The frame backbone had been so designed that the new De Carbon-type rear shock absorber fitted inside the tube and was attached to the headstock by a bolt that passed through both the backbone and upper eye of the suspension unit. This design resulted in a lower centre of gravity, as the upper rails of the frame had previously passed over the monoshock unit. The new rear shock had discarded the awkward canister containing the nitrogen under pressure and the diaphragm separating it from the oil in the shock. It looked much like a conventional

shock absorber with a half-length external spring. Preload adjustment was possible but necessitated the removal of the unit from the bike. Damping, both compression and rebound, was more easily adjusted with the unit *in situ*. A knurled ring at the top of the unit was accessible via a hole in the frame backbone and could be turned by a screwdriver. As the ring was turned, a rod within the unit was screwed in or out and the tip of the rod restricted or eased an oil jet, giving infinite damping adjustment. The material of the rod was so designed that as the oil temperature rose, the expansion of the rod would compensate the reduced viscosity of the oil by its increasing restriction of the oil jet. Ingenious.

The front suspension remained air-charged, but this was no longer an eye-grabber, since the air cannisters at the fork top had disappeared. The sophistication of the C-model forks had proven too difficult for the average rider to set up properly, so Yamaha bought in Kayaba air forks with a leading-axle. The air pressure was used primarily to prevent mechanical bottoming of the front fork, and not as a replacement or enhancement to the coiled springs. Leading-axle forks were coming into vogue in the mid-1970s as the manufacturers worked on increased wheel travel and found that the wheel axle at the end of the fork was in the way and correct steering geometry was not possible on the long forks with the conventionally placed wheel axle. With the same braking power as the X model, the retaining rod for the rear brake plate was replaced by a tongue and groove arrangement fastening it to the swinging-arm and preventing it rotating as the brake was applied.

The finished article weighed in at 88.5 kg, the lightest 125 motocrosser available despite the mild-steel frame and swinging-arm. The D model steered like a dream, going exactly where pointed, and the low weight and centre of gravity making it easy to throw about. The suspension was extremely good at both ends, the compliance of the rear end seeming to have been

improved considerably. There were some reports of swinging-arm flex but it was not noticed by all tests of the period. The wider powerband made the 125D a lot easier to ride. The price was a slightly lower top end making the machine less attractive to expert riders who were happy with 1000 rpm wide powerbands. The clutch was a little too sensitive making it difficult to get the bike cleanly away from the start line without stalling or lifting the front wheel.

The amount of detailing on the bike showed how important the ergonomics of the machines were becoming. Properly cleated footpegs, soft foam handlebar grips, large neck to the plastic petrol tank, a front mudguard that provided real protection to rider and machine, plastic drive chain tensioner were all small details that added up to an excellent functional motorcycle. When lined up with the competition, there were two that could run with the 125D, one surprising, the other not. Once again Suzuki were there with a touch more power throughout the mid-range and top end and a suspension to match the Yamaha. Surprisingly, both Japanese machines were bested by one of the last traditional and competitive European motocross machine manufacturers—Husqvarna. Expert riders found the sharper and significantly higher power output combined with an excellent chassis much to their liking; the extra \$400 over the Suzuki and Yamaha was not.

The same chassis was to be found on both the 250 and 400 models, using the design found on the 125. A small change was the use of a thick aluminium plate to act as mounting point for the rear engine bolts and to provide further bracing to the frame behind the engine. The mill of the 250 changed nearly as much as had that of the 125. The new 250 cylinder contained taller transfer ports and a wider exhaust while the inlet was lowered a touch to give more support to the inlet side of the piston. The new cylinder head raised the compression ratio a fraction. As on the 125, the bore of the carburettor throat came down



Lucky recipient of the YZ kettle was Gerard Rond who put it to good use by finishing runner-up in the 1977 World Championships

a size from 38 mm to 36 mm, matching the shrinking of the inlet port. The single air filter element was located under the right-hand side-cover. All five speeds of the 250 were lowered significantly, but the spacing widened slightly to take advantage of the incredible increase in mid-range power over the 250C, due to the new porting and exhaust pipe. The clutch, common to both 250 and 400, lost two plates without any noticeable problems and the gearshift drum

gained an outer roller bearing on which to turn, to eliminate any stiffness in the gearchange. The 400 underwent less engine changes, being restricted to new cylinder and head, exhaust, clutch, gearshift drum and air filter.

Both 250 and 400 were right at the top of their class, the 400 undoubtedly the king of the open class. The 250 was a revelation in comparison with its peers, where engines were either peaky and powerful or flat and feeble. For the first time

there was a quarter-litre with a respectable top end and a sensational mid-range output. With more than 240 mm of travel at both ends of the bike, excellent steering geometry, at long last two effective brakes and a really comfortable riding position, the 250 was a very good machine. The 400 was virtually unbeatable, with considerably more power than the competition, and all the good handling characteristics found on the 250. In 1977, Yamaha had a range of motocross machines to be proud of.

The year 1977 proved to be a good one for the factory teams on both continents. In Europe, the hard man of Grand Prix motocross had been bought in from Husqvarna, Heikki Mikkola. Mikkola was capable of doing astonishing things with uncompetitive machinery, so when he was handed the factory 400 for the 1977 World Championship, he was almost certain to take the title. Nor did he disappoint the company for with nine wins out of a total of 18 legs, he easily brought Yamaha their first 500 motocross world championship title. In the 125 class, Dutchman Gerard Rond gave the god of the 125 class, Gaston Rahier, and his Suzuki a run for his money which resulted in Rond taking second place and Rahier his third successive 125 world title. When Yamaha had hastily withdrawn their water-cooled 125 from US competition during 1976, they decided to make use of it in the world championships. Rising-star Rond was entrusted with the machine but received no financial support from the factory. The maintenance of the machines was left to the experienced hands of Lucien Tilkins and the bike was the fastest, if not the most reliable, in its class for 1977 and 1978.

In the US, Bob Hannah and newcomer to the team Broc Glover, gave the factory every reason to be pleased with the year's results. During the winter of 1976/77, Hannah added to the aura that was building round him by winning all eight races of the Florida winter-AMA 250 series on a bog-standard YZ250C. Even when the works YZ250D machines became available Hannah

persisted in using the standard bike to total 12 unbeaten races. He went on to take the Supercross championship, winning six of the ten rounds. In the National 500 class he was pipped by Marty Smith on the works Honda but still won two of the six rounds. The 125 National championship turned into a real nail-biter that went all the way to the last moto. Seventeen-year-old Broc Glover joined the Yamaha team after a successful year riding his own Elsinore in 1976 and ending up 5th in the National standings. He joined National champion Hannah in the 125 class and it was immediately clear that he was not going to be guarding Hannah's back. A three-way battle developed between Danny La Porte on the Suzuki and the two Yamaha riders. La Porte won the Hangtown opener, then Hannah won twice, then Glover and then Hannah again. Going into the last meet at San Antonio La Porte had 200 points, Glover 190 and Hannah 183. The complete Yamaha US motocross team, Mike Bell, Pierre Karsmakers and Rick Burgett, was entered to cover whichever Yamaha rider needed help. Glover won the first moto, shrinking La Porte's lead to five points. In the second race, Hannah built up a 30-second lead until team orders were made clear and Glover was let through to win the moto, meeting and National title by virtue of the same number of points as La Porte, but two meeting wins to the Suzuki rider's one. You can't get much closer than that!

By September 1977, the 1978 models were already being assembled in Japan. Once again the complete line-up from 80 cc to 400 cc were updated, in the case of the 125 and 250 as significantly as the C to D transition. Yamaha were pursuing a philosophy of continuous evolution, characteristic of all Yamaha's machine development. In 1978, the dangers of such a system were clearly demonstrated as the factory slipped behind the competition in some of the classes.

The YZ80E minicrosser went monoshock. At last Yamaha's trademark in the motocross world had been extended to the complete range. A De



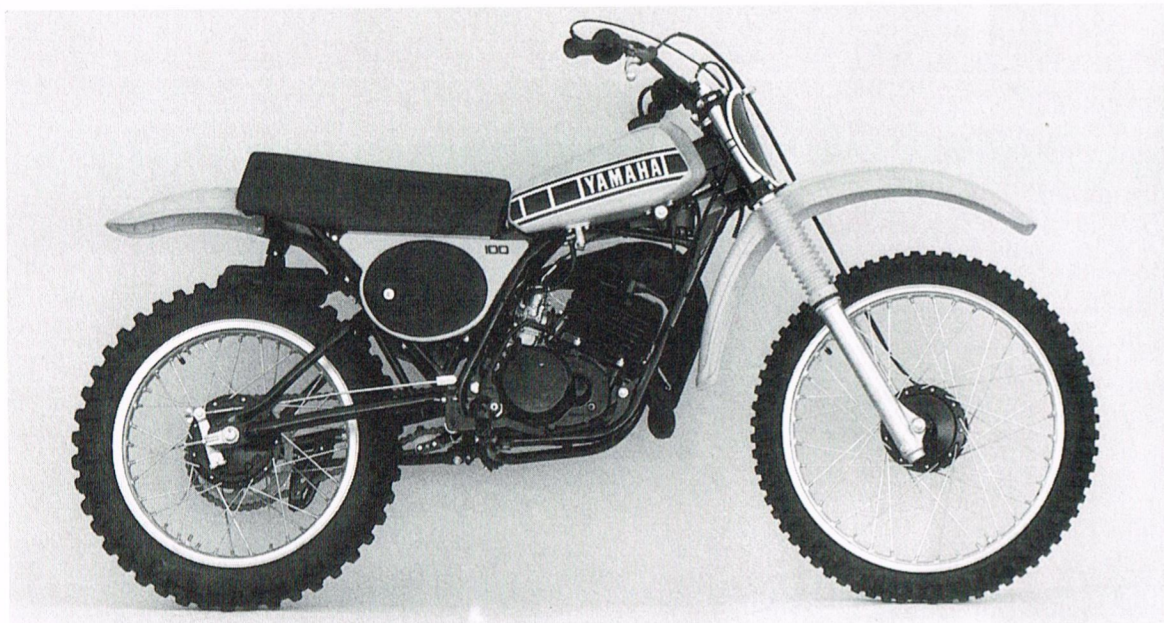
Bob Hannah at the peak of his career in 1977 when he effortlessly won the US Supercross title and was runner-up in the 500 and third in the 125 class

Carbon-type shock, much shorter than the one found on the larger YZs, was mounted under the seat, the lower end bolted to the apex of the upper swinging-arm fork, the upper to the bottom of the frame backbone tubing. The frame was similar to that used on the rest of the YZs, with a single large-diameter backbone tube and a double-cradle engine support. Rear wheel travel increased 35 mm and a larger chain and a chainguard were fitted, as well as a wider rim for the rear tyre. Front fork travel increased a fraction with the provision of leading-axle forks. Rake was one degree less steep than the D model, improving straight-line stability at the expense of sharpness of cornering although pulled-back handlebars offset some of the steering slowness.

In the engine, almost everything changed. Narrower crankcases held a new crankshaft, revised to enable the new CDI rotor to be keyed to its left half. A two-ring piston replaced the single Keystone item. In the cylinder two extra transfer ports were added to the two previously

used, matching the layout that had been universal on the other YZ models from their inception. An extra pair of plates were added to the clutch and the transmission ratios closed up. Weighing in 2 kg more than the D model, the YZ80E and RM80C of Suzuki were evenly matched in all the areas used to evaluate motocross machines, power, handling, suspension and brakes.

Having marked time for a year with the YZ100D, Yamaha had to make up their minds to either quit the class or perform a much-needed upgrade. They decided on the latter, not content to leave the class to Suzuki. Engine changes included radial cylinder head, base-mounted cylinder, peakier porting in the cylinder, a thinner flat ring in place of the Keystone ring, a shotpeened crankpin for extra reliability and a straighter exhaust helping peak revs. The chassis was updated along the lines of the large-diameter backbone found on the other YZs, except the pipes of the double cradle looped up to the base of the backbone pressing, instead of supporting the rear subframe. Travel on both

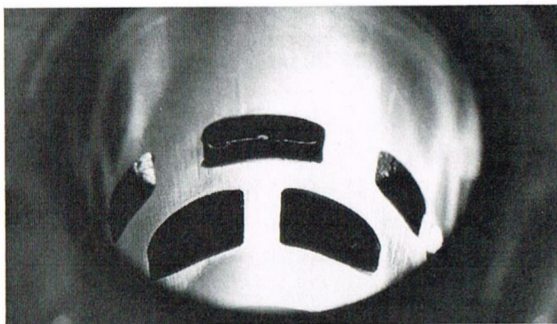


Above Winner in a class of two was the YZ100E whose stronger engine made it a better machine than the Suzuki

Right Reliability considerations forced the adoption of both vertical and horizontal bridges on the YZ125E cylinder inlet port

front and rear suspension dropped a little, presumably in the interests of reducing seat height for the youngsters expected to go for the 100 class. The front forks were not air-charged as other larger YZs but were equipped with leading-axle fittings. With a number of detail changes such as a plastic fuel tank and bonded transfers, the YZ100E was considerably better than the D model. When it came to the RM100C, it was the YZ every time, the RM offering a little more power in the mid-range but losing out at the top end, and the steering and handling competent on both machines. With a single dollar price difference in Yamaha's favour there was little need to choose between the two; the Yamaha was better.

The philosophy adopted by the factory for the



YZ125E seems to have been one of correcting deficiencies reported for the D model rather than developing any major new ideas. Deficiencies covered both a number of items on riders' wish lists as well as some changes to improve reliability. The 125 followed the lead taken with the 400C in 1976 when the inlet port was bridged to provide better support for the piston skirt. At 45 mm, the width of the intake port represented 80 per cent of the bore of the cylinder, while the maximum acceptable percentage was considered to be 75 per cent. Above this value, sup-

port for the piston was insufficient and cracked skirts would be the result. With the bridge in place it would be possible to open up the intake even more, 85 per cent of the bore being the accepted maximum. There was a slight penalty to pay for the use of a bridge in that the bridged port can only flow about 85 per cent as well as an unbridged port of the same area. On the other side of the cylinder, the gaping 41 mm wide exhaust port was also at the limit as far as width was concerned since it represented 73 per cent of the cylinder bore. At anything over about 71 per cent, the chances that the rings would bulge into and catch on the upper edge of the port increased enormously. The single Keystone ring of earlier models was replaced by two plain rings as on the other YZ models, at least doubling up on the gas seal. The ports in the iron liner of the cylinder were covered with a very thin paint-like coating that produced a really smooth bore and reduced gas flow disturbance. Smooth bores of ports always help get the maximum power from the engine and in mass-produced castings the bore is anything but smooth. In order to provide the maximum space for the new ports, the long-reach studs passing through the cylinder casting were replaced by base-mounting studs.

The polyspheric combustion chamber of earlier 125s was replaced by a simple concentric squish band chamber. The shotpeened crankpin was shared with the YZ100E, but the rest of the crankshaft remained unaltered as did the transmission, clutch and ignition. An attempt was made to widen the powerband of the engine a little by the redesigned exhaust pipe, whose rear cone taper was very long, providing a less powerful positive stuffing wave at the exhaust port to return any charge lost from the cylinder, but effective over a wider engine speed.

The weight of the new 125 was down by 2.5 kg and the saving came mainly from the new chrome-molybdenum frame that replaced the mild-steel item of the past. Not only is chrome-

molybdenum lighter than mild-steel, but also stronger, enabling the wall thickness of the frame tubes to be reduced. The rear swinging-arm was also fabricated from a new material, aluminium. After a small cottage industry had built up in the US offering aluminium box-section swinging-arms to YZ owners unhappy with the flex they found with the standard item, Yamaha took the logical step and introduced them on the 125, 250 and 400, saving themselves almost a kilogram in the process and adding 20 mm to the wheelbase for extra straight-line stability. Attached to the swinging-arm was a loop of aluminium to protect the chain and the tensioner, which had been moved closer to the rear wheel, thus providing better engagement between the rear wheel sprocket and the drive chain. Overall travel on the front fork did not increase, but the inner and outer tubes were lengthened to provide greater overlap support and consequently reduce fork flex. The rake was set one degree less at 30 degrees in an attempt to correct the age-old criticism of Yamahas, the slow steering.

So the Yamaha 125E had undergone some updates to make it a better machine than its predecessor. When tested alone it proved to be a good machine, with no apparent suspension flex at either end and a noticeably more powerful engine. The major criticism was that it would not change gear with the throttle fully open. This deterioration in shifting qualities could only have been due to the extra power of the engine as the transmission had not changed. When raced back to back with two other new 125s, the Kawasaki KX125 A4 and the Suzuki RM125C, the lack of mid-range power became apparent and the narrowness of the powerband. Kawasaki in particular were proponents of the leapfrog development process and after years of uncompetitive 125s were back with a vengeance with the best machine available. With both the RM and the KX spraying dirt over the YZ, Yamaha's record of excellence in this class had taken a sharp knock.

Although the D models had proven to be good machines, the 250 and 400 were updated for 1978. Both 250 and 400 underwent the same chassis changes that had been made to the 125, but whereas the engine of the 400 remained unaltered for the E series except for a shorter piston inlet skirt, that of the 250 was completely redesigned. The common frame changes involved the use of chrome-molybdenum for the tubing as well as the slightly longer aluminium swinging-arm. Also the front forks offered the same travel as the year before but were stiffer due to greater overlap of the inner and outer tubes. Although the rake of the 125 had been pulled back one degree, that of the 250 and 400 remained steady at 30.5 degrees.

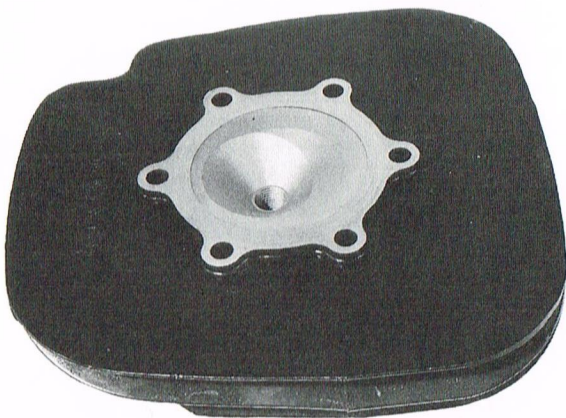
The prime objective of the design team for the 250 engine seems to have been to get the weight down, and in that they were commendably successful. The engine unit lost a fantastic 7 kg, despite the addition of an extra speed in the gearbox, but in the process pushed the power output up the scale and made the 250 a touch peaky. All the main engine components were new. The crankcases were cast in aluminium, a compromise between the cheap and heavy alloy cases and the light but expensive magnesium alloy cases usually only found on works machines. The right-hand crankcase cover was, however, made of that precious alloy as well as the front and rear brake backing plates. Whereas the cylinder head of the 125 machine had changed from a polyspherical combustion chamber to one with squish band and centrally located spark plug, the 250 went the other way. The plug was moved 5 mm towards the rear cylinder wall, with its own small-radius pocket located within a large-radius pocket and a thin strip of squish band round the outer edge. Reasons for the move were probably a combination of worry about overheating of the exhaust side of the piston crown and redirected transfer ports that aimed the fresh charge towards the rear of the cylinder forcing the plug position to move too,



Above Most striking change to the YZ series for 1978 was the use of an aluminium swinging-arm, illustrated here on the 125



Above The 1978 version of the factory water-cooled YZ125 which enabled Gerard Rond to once again mount a strong challenge to the all-conquering Suzuki team



Above The polyspherical combustion chamber found on the YZ250E

if it was to benefit from the cooling the charge stream would perform.

The porting of the 250 changed a little in what would seem to be a quest for more power, which was found at the expense of powerband width. The exhaust port was opened up 2 mm bringing it into the danger zone for piston ring failure. The height of the transfers was reduced 2 mm to give the scavenging process longer to complete its task of cleaning out the exhaust gases. As on the other YZ machines, the ports were coated with a film to smooth the gas flow through them. A 38 mm Mikuni fed the inlet port via a 10 mm wider reed case assembly, helping to get more fresh charge into the crankcases and of course a new exhaust pipe was developed to match the new port dimensions of the engine. As well as getting the two-ring treatment, the piston also had small vertical grooves cut in the lower section of its skirt. This was intended to improve the oil retention of the piston surface and provide a lubricating cushion between the piston and cylinder wall when subjected to high loads. Hopefully seizures would be virtually eliminated.

All engine shafts were shorter to fit the narrower crankcases. The left-hand half of the crankshaft was shortened by having a much smaller taper for the CDI ignition rotor; the right-hand half remained unchanged. Thinner gears were used throughout the transmission, enabling an extra speed to be squeezed into the smaller width dictated by the narrower engine. The extra gear helped keep the engine within its peakier powerband but really treated the symptoms rather than the disease. Kickstarter and the gear selection mechanism were modified to work with the new six-speed gearbox and a 10 mm longer gearchange lever fitted to increase leverage and make shifting easier.

How did the 250 and 400 perform on the racetrack? The chassis changes alone made the E models better than the Ds. Rear swinging-arm flex was eliminated with the aluminium fork, and the frame and front forks seemed equally rigid.



While a large improvement over the D model, the 1978 YZ250 was still bettered by other Japanese machines, due mainly to a weight problem

Having lost a total of 4 kg the 250 was in the same class as its competition but the bike still felt a little heavy due to the position of the monoshock high in the frame. When matched against the other Japanese creations, the 250E's power characteristics let it down, since the others had more mid-range power making them easier to ride. For expert riders that wouldn't have been too much of a problem but for the other 90 per cent of motocross riders it would. The transmission seemed to have suffered as a result of redesign for it felt stiff and came up in neutral often enough to threaten the health of the engine. The problem lay in the close tolerances found in the ultra-compact gearbox. When riders used normal weight gearbox oil, the problem occurred, but with lighter oil everything was hunky-dory. The 400 remained king of the open class, despite the lack of engine development. With 40+ bhp on tap, it had plenty of power and with a frame that was better able to get it to the ground, it was almost unbeatable.

The most successful year of motocross competition in Yamaha's history was 1978. In the US, all the National titles were won by the Yamaha team, a feat never achieved by a manufacturer before or after. In the 125 class Broc Glover won



Above **Broc Glover** was the undisputed king of 125 motocross in the US during 1978



Left **The first sighting of a power valve on a motocross model occurred in 1978 when this works 250 appeared at the last race of the Japanese National Championships**



the title more conclusively than the last-moto decider of 1977. With a total of 13 moto wins out of a total of 20 races, he ended the series 110 points clear of second man Gaylon Mosier on the Kawasaki. Bob Hannah maintained his reputation as the hardest rider in US motocross by cakewalking the 250 championship, winning 14 out of the 20 motos, including eight overall wins. The Supercross title he had won in 1977 remained his as he beat Honda's Marty Trippes by 52 points in the final standings. At one point in the year Hannah had won 22 consecutive motos, recording the longest winning streak in US motocross history. Finally, in the 500 class, Rick Burgett came good after a poor year in 1977 and headed a Yamaha 1-2 in the class. Second man was Rex Staten, riding the first half of the year on his own YZ400E, but later getting the

Europeans never got much of an opportunity to see Bob Hannah in action. Once exception was the Motocross des Nations of 1978 held in Gaildorf in Germany, when he was only bested by Mikkola

loan of injured Mike Bell's works 400 to close the season. In total Yamaha machines had won 40 out of a total of 60 motos in the National series, an incredible achievement.

In Europe Heikki Mikkola retained his 500 title, winning 14 of the 24 motos along with two 2nd places, six 3rds, a 6th and a single DNF in Sweden when the drive chain broke. Without a contender in the 250 class, still very dominated by European machines, the 125 representative was Gerard Rond who was classified as third despite tying on points with second man Gaston Rahier. By virtue of his five overall wins to Rond's three,



Rahier was given 2nd place behind Suzuki teammate Akira Watanabe.

In 1979 the F series of machines were introduced and were likely to be in big demand in the US after the factory's domination of the US National series. The production machines had a lot to live up to. The YZ80 had been at the top of the class since the introduction of the B model in 1975. In 1979 it was to remain there, with a number of engine and chassis changes consolidating its position. A combination of new cylinder porting, head and exhaust served to increase the power output to 14 bhp at 11,000 rpm, without excessively narrowing the powerband. A sixth-speed overdrive was added to the gearbox, with the ratios for the first five gears remaining the same. The frame was extended into a full double-loop cradle of tubes as opposed to the pressed-steel rails under the engine on the E model. The change was prompted by frequent reports of

Pierre Karsmakers flying high on his 1978 US works 250

frame cracking on the E model, at the joint between the front downtubes and the pressed-steel rails. The YZ was more powerful and steered as well as the Suzuki and Kawasaki opposition, and although its suspension gave second best to the Suzuki, it was these qualities that made it the winner.

The YZ100F was functionally identical to the E model, the only distinguishing mark being the factory's name in 50 mm high white lettering on the sidewall of the seat. The engine was still a killer, vastly more powerful than the new Suzuki, which in its turn was a vastly superior handler. In stock form, the engine of the YZ just about pulled the Yamaha through but with some money spent on the engine the Suzuki would prove to be the winner.

The 125 didn't get into 1979 without some

work, as always to raise power and improve handling. New cylinder, high-compression head, exhaust pipe and rejetted 32 mm Mikuni helped the YZ to a claimed 20 per cent improvement in power output that would have added another 4 bhp to the top end. This seemed a little wide of the mark although an improvement was noticed in mid-range power. Despite the increase in power, a pair of plates were removed from the clutch. The rake of the frame was pulled back 0.5 degrees to 29.5 degrees to help quicken up the steering. The frame design was not changed but extra gusseting was provided at the headstock/frame joint. Despite the use of a thermostatic valve in the De Carbon-type rear shock absorber, to regulate the size of the oil jets as the temperature of the oil increased, the E models had suffered from monoshock fade towards the end of 40-minute motos. The F-model rear shock had cooling fins along the length of the shock absorber body instead of the radial fins of the previous year, as well as a slightly stiffer spring. An extra 20 mm of front fork travel was added but the total of 250 mm was far less than that offered on competitor machines.

The track test of the YZ125E demonstrated 1979 not to be a vintage year for the Yamaha 125 model. Both Suzuki and Kawasaki had better, more compliant suspension and comparable power output. The shorter suspension travel of the YZ as well as the monoshock design did result in a lower seat height which combined with the steepish rake to enable the YZ to be easily flicked through fast S-bends. But by and large the YZ125F did not live up to the reputation set for it by Broc Glover's domination of the National 125 series.

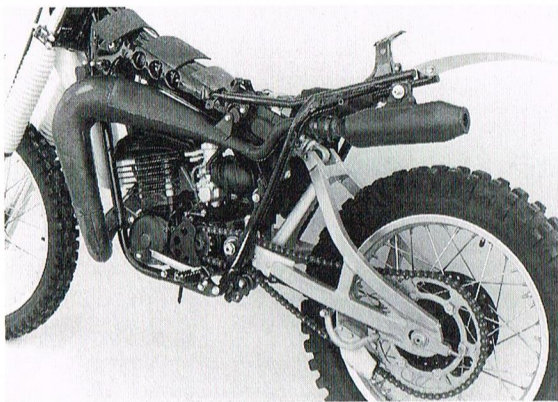
The 1979 YZ250 appeared to be identical to the previous year's model except for the position of the number plates on the side panels. In fact the 250 had yet again undergone a major update. The engine changes were aimed at widening the peaky powerband of the E model that had made it a machine that only experts

were able to get the best out of. The exhaust and transfer ports were lowered 3 mm and an exhaust pipe fitted with fatter mid-section and reverse cone all of which would contribute towards greater mid-range power at the expense of the top end. New gearbox ratios were selected to make better use of the wider powerband with a higher first gear, second and third unchanged, and slightly higher fourth, fifth and sixth. The better power at the low end made the YZ easily able to handle second gear starts. The RT1 crank-pin that had seen many years of service in YZ250 and 360/400 engines was finally replaced by a shotpeened equivalent as used on the smaller YZs. A double-thickness air cleaner element was fitted and the air flow to the carburettor improved by better venting through the side-cover.

Changes to the chassis were similar to those made on the 125. A one-degree steeper rake to quicken the steering, a 35 mm longer swinging-arm increasing the wheelbase and rear wheel travel, 20 mm increase in front wheel travel, aluminium body rear shock absorber with longitudinal cooling fins. Worthy of special mention was the adoption of a full-floating rear brake. A torque arm was bolted to the rear brake backing plate and to the bottom rail of the frame just behind the footpeg. The result was excellent chatter-free rear braking power. Also the engine was dropped 25 mm in the frame by the use of new mounting plates, which lowered the centre of gravity.

These changes brought the YZ250 right back into the ring with the best of the 250 machines. With an edge over the Honda and Suzuki in the engine department and steering characteristics as good as could be found on any bike, including the legendary Maico, it was only the stiffer rear suspension and 50 mm less travel that could be counted against the YZ.

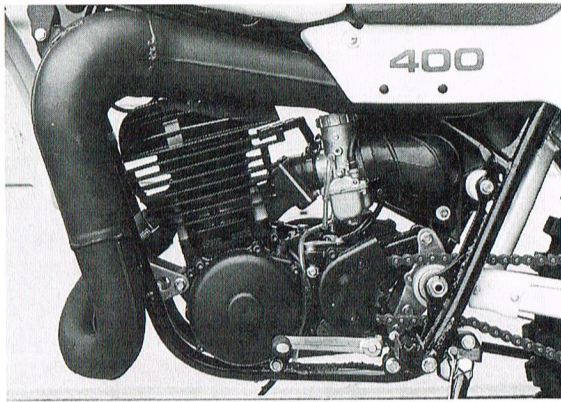
The final bike in the YZ range for 1979 was, of course, the open class YZ400F. Once again deceptively little had changed externally, but the



The YZ250F laid bare and exposing the chassis design that dated back two model years to the 1977 D series

engine was a complete redesign. Having skipped a year with the E model's unchanged engine, the passing of another year without update would have been fatal in the YZ's battle with the Maicos, Suzukis and Husqvarnas in the open class. Primary design objectives were to narrow the engine to enable the weight thus saved to be better used elsewhere and as always to broaden the powerband. Rather than spending too much time juggling with port dimensions, the factory lengthened the stroke of the 400 from 70 mm to 75 mm with a corresponding reduction in bore from 85 mm to 82 mm to give a displacement of 396 cc. Long-stroke engines are usually torquier than their short-stroke brethren, which in their turn give higher peak power output. Without any changes to the inlet port dimensions, the new bore and stroke meant that it was open for 32 degrees more of the crankshaft rotation. The exhaust port height was raised 2 mm and the main transfer ports widened 7 mm. Thus more charge got into the crankcase through the inlet port, the transfers were widened to flow it into the combustion chamber and the exhaust opened earlier to give the charge slightly longer to scavenge the cylinder.

Complementing these cylinder changes were



The engine of the YZ400F had a super-wide powerband providing plenty of gutsy torque

an exhaust pipe similar to that on the 250 with a very fat centre section and a 10 mm wider reed assembly, an update that had been made on the YZ250E. Although the volume of the hemispherical combustion chamber had been reduced slightly, the effective compression ratio dropped due to the higher exhaust port roof. Lower compression ratios are associated with torquier engines. Some of the weight saved by the narrower engine went into the crankshaft, as the F model had noticeably more flywheel effect.

The combined effects of these changes were to bring the peak power of the 400 down 4 bhp, without a decrease in maximum torque but with a healthy fat 3000 rpm powerband. Power delivery from 4000 rpm was smooth, constant and meaty right up to the peak at 7500 rpm before signing off 500 revs later. The engine was as strong as anyone at the time could want or imagine. With the need to produce a new, more compact gearbox to match the narrower crankcases, the opportunity was taken to cut slightly lower overall ratios, although the difference was not significant. The 400 and 250 used the same chassis and the larger bike benefited just as much as its smaller brother. Steering was precise and quick enough to enable the rider to steer

Right The 1979 YZ400 was generally accepted as being the best open class machine on the market



Below In 1979, Bob Hannah was still the best motocross rider in the US



round tight corners or go for the berm shot whichever he preferred. The suspension was spot on at front and back, although the monoshock still tended to fade after about 20 minutes when given a workout by an expert rider. The 1979 YZ400F had gutsy power, precise steering, competent suspension, powerful brakes, light weight, good looks and a low price. In the words of *Cycle Guide*, it was: 'So close to the best that only the best will ever know the difference'.

The US Yamaha factory team were once again the dominant force in the AMA National series in 1979. Broc Glover walked off with his third 125 title after only slightly more pressure from Suzuki's Mark Barnett than in 1978, when Barnett's challenge had ended with a bad mid-season crash. Bob Hannah had equally little difficulty sewing up the 250 and Supercross titles, bringing his tally to a record of six National titles. The only blot on the perfect copy book was the three-point defeat of Mike Bell by Suzuki's Danny La Porte in the 500 championship. In Europe the factory did less well. Gaston Rahier took over Gerard Rond's place in the 125 team but his chances of making a serious run for the title were badly dented in the first GP in Austria where he crashed heavily in the second moto and dislocated a shoulder. Missing the next round and taking it easy in the following two, by the time he was fit again, the Suzuki duo of Harry Everts and Akira Watanabe had built up an unassailable lead, the title going to Everts. The 250 class was not contested by the factory team and Mikkola was hunting for his 500 title hat trick. Unfortunately for him, 1979 proved to be an injury-plagued year which started with a pre-season training injury to a knee. After missing the Austrian round he was getting back into his stride again by the Canadian GP where he crashed very hard and badly bruised his ribs

causing breathing problems in racing conditions. By not scoring in either the Canadian or subsequent German rounds, Mikkola's chances of retaining the crown disappeared and he ended the season a disappointed 5th place in the championship. At the end of the year Mikkola announced his retirement from the sport after nearly ten years at the top and with three World Championships to show for all the battering his body had taken. His name could be added to the list of great Scandinavian motocrossers who had come, seen, conquered and sadly departed.

By the end of the 1970s the Japanese domination of the motocross sport was almost complete. Certainly the greatest percentage of motocross machines sold came from the Big Four, with Yamaha and Suzuki making the front running. Yamaha's success in the US had been devastating, the combination of good machines with enormously talented riders had led to their total domination of the sport by the end of the decade. But the pressure was really on. Yamaha were at the pinnacle of their motocross success, and when you're at the top there's only one way to go.

The factory team's success had led to Yamaha's position at the top of the sales charts for off-road machinery in the US, the factory's corporate philosophy of sales through racing successes completely endorsed. By and large, the YZs were very good machines, benefiting from the factory's direct link with the sport, through a careful, considered annual update of the design. This philosophy of continuous evolution seemed to have worked well enough in the first years of the YZ series. Would it continue to be satisfactory in the eighties?

Heikki Mikkola—one of the great men of motocross sport

