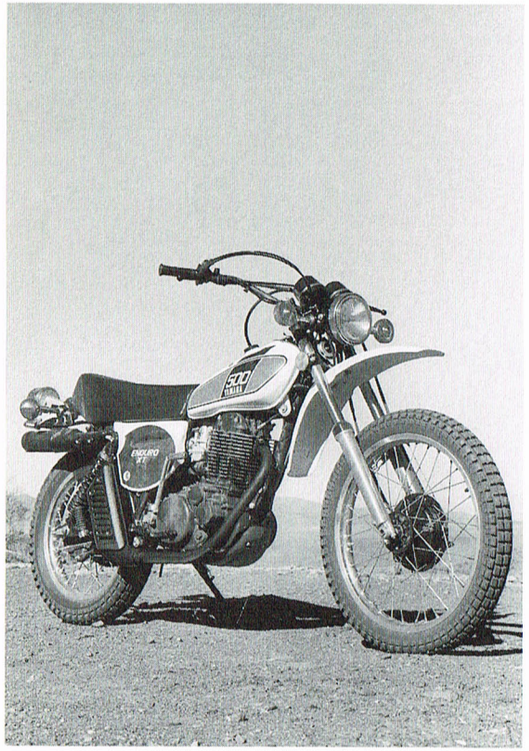
9 Rolling thunder



The 1976 XT500C initiated the start of the four-stroke thumper revival

Until 1970, every one of the 172 motorcycles that Yamaha had produced had used a two-stroke engine. With the turn of the decade, Yamaha indicated the direction in which future developments would proceed by announcing their Triumph Bonneville clone, the XS1. There were two clear reasons for the company's move into the world of four-strokes. Firstly, they were anxious to get a slice of the large-capacity market that Honda were threatening to monopolize with the introduction of the four-cylinder CB750. There were few good reasons for using the two-stroke principle on large-capacity machines, the four-stroke multi being able to produce enough power and retain air-cooling. Secondly, the anti-pollution lobby in Europe and the US was becoming increasingly vocal in its plea for tighter restrictions on exhaust emissions. Once these were introduced, the two-stroke would be strangled to death. So in February 1970, the four-stroke 650 twin began production, the engine format resulting from Yamaha's decision to compete with the ailing British industry and not to be accused of copying Honda by the introduction of a four-cylinder machine. Within a couple of years, the range of four-stroke twins had extended to include a 750 and 500. Clearly the four-stroke would play an increasingly important role in Yamaha's product line.

During the last decade of its existence as a powerful force in the motorcycle industry, British manufacturers had attempted to produce a range of what could be considered dual-purpose motorcycles. BSA had introduced the trail version of the B25 in 1971, known in the US as the Starfire and in Europe as the Barracuda. It joined the 500 Victor enduro that had been available since 1966, initially with a 440 cc engine, with both scrambling and roadster variants being available. The enduro models had been conceptually similar to the DT/RT series Yamaha had introduced at the end of the 1960s, but unreliability and brain-scrambling vibration gave them, and indeed many of the British machines, a bad name. It was a pity, for the Victor, when it ran, was a competent machine with 34 bhp on tap at 6200 rpm. Another well-conceived British idea that was ruined on transfer from paper to metal.

Within two years of Yamaha's introduction of the DT1, both Kawasaki and Suzuki had equivalent machines in their model range. For some reason Honda held back and it was 1971 before the SL and later the XL series were offered for sale. For the XL series, initially 250 and 350 bikes were produced but the range soon expanded to include 175 and 125 capacities. These were the first four-stroke dual-purpose machines made in Japan, but the upper limit of 350 cc precluded a direct comparison with the recently expired British thumpers. Functionally, they were very similar to the DT series, with good engine performance, reasonable handling and barely adequate suspension. They sold well, well enough to make Yamaha sit up and take notice.

Yamaha were well aware of the danger facing their DT series. The way things were going, the EPA would have ensured that all roadgoing two-strokes would be outlawed by the end of the 1970s. With this US ban on them, the DT series would suffer a body blow it would be hard to sustain. Worse still, Yamaha would lose a major sales market. Clearly a move would have to be made towards four-stroke dual-purpose machines. The confrontation with Honda could not and would not be avoided.

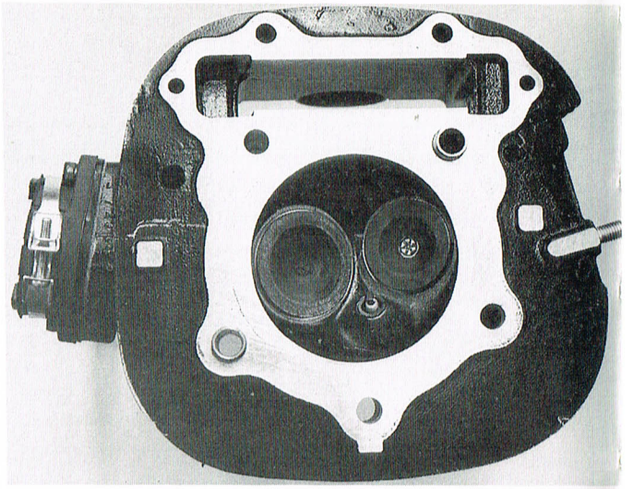
Once the decision had been taken to build a four-stroke, the capacity of the bike that would form the advance guard of the new series was almost a foregone conclusion. Two factors made the choice a simple one. The new bike should not be a direct competitor to the existing DT models and if possible it should put one over on Honda. Honda's top of the range was a 350, lacking some of the aura of the old British 500 cc thumpers. Top of the DT range was the 400. A 500 would be a perfect choice. The letter 'X' had been chosen to represent a four-stroke model and since it was a 'Trail' machine just like the DTs, it would receive the designation XT. A number of prototypes were constructed during 1975 and at the US dealer convention in September 1975, the XT500C was unveiled to a startled world.

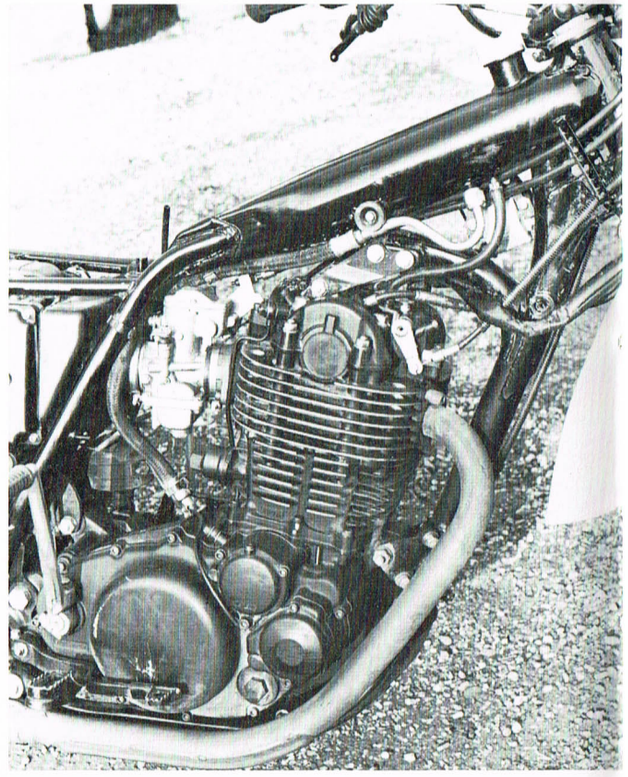
The bore and stroke of the big single were an almost square 87 × 84 mm in contrast to the longer stroke of the British bikes. One of the problems of the BSAs and Triumphs had been the height of the engine, which had compromised the amount of ground clearance possible. The shorter stroke, coupled with smaller crankshaft flywheels and a dry sump kept the height to a minimum. The overhead camshaft, running on ball bearings, was driven by a chain passing through a tunnel on the right-hand side of the engine. A two-valve head was used since the intention was to produce a mill with a pancake-flat torque curve and reasonable power and this could be achieved without the complexities of the four-valve head Honda were using on their XL series. Bearing in mind the infamous starting habits of British singles, a decompression device was fitted that pushed the exhaust valve from its seat when a lever on the left-hand handlebar was squeezed. The head was attached to the cylinder by four studs and the cylinder to the vertically split crankcases with four more studs.

A conventional slide-operated Mikuni carburettor of 34 mm diameter was used, although

it looked rather like a constant velocity carburettor due to a push/pull mechanism that was required. This was necessary since the carburettor, situated high on top of the engine under the petrol tank, could not be operated by the usual centrally placed cable. Instead, the cable operated a pulley mounted on the side of the carburettor body that would raise or lower the slide as the cable throttle was turned. The air filter was located high and dry under the seat. On the exhaust side, the pipe was not upswept as would be expected, but ran down under the engine, to a larger box angled up behind the engine. The final section of the exhaust pipe with the silencer and spark arrester ran parallel to the seat. This set-up was reminiscent of that used on the BSA trail machines, but it was not a satisfactory arrangement. When riding in the dirt, the exhaust was the part of the bike that received the most punishment and was easily damaged. Apparently Japan had insisted that this form of exhaust was used despite criticism from US prototype riders. Later they were to listen more sympathetically to the same criticism from owners of the XT500C.

The pressed-up crankshaft used full-circle flywheels, with a roller bearing for the big-end and a plain copperized bearing for the gudgeon pin. The magneto was keyed to the left-hand end of the crankshaft, with the contact breaker assembly driven separately from the right-hand end of the crankshaft via an idler gear. The crankcase was fitted with a Positive Crankcase Ventilation (PCV) system which circulated oily fumes in the pressurized crankcase through a hose to the air cleaner, where the condensed oil seeped back down to the gearbox. A cleaner exhaust was the result. Rather than use a separate tank





Above right **A two-valve head was deemed sufficient for the XT500 to produce the gut-wrenching torque Yamaha were aiming for**

Right **The backbone of the frame acted as an oil reservoir for the XT**

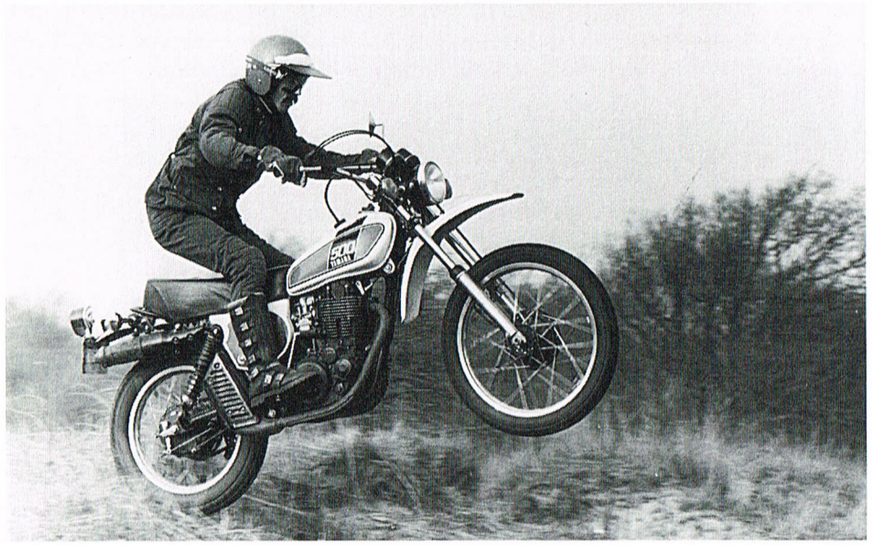
to hold the oil that was pumped through the engine, it was stored in the large-diameter backbone and downtube of the frame. The filler/dipstick was located just behind the headstock in front of the petrol tank. Two Eaton-type trochoidal pumps driven by the same shaft were used to flow the oil, one returning circulated oil from the sump to the frame reservoir and the other delivering oil via a gauze filter to the crankshaft and via an external line to the camshaft.

Straight-cut gears were used to transmit the power to the gearbox via a 15-plate clutch spring loaded to the primary transmission gear in true DT fashion. The five-speed transmission was of conventional design with well-chosen ratios, although the gap between the first two gears was a little wide. The gearchange mechanism used the rotating drum common to all Yamaha's dirtbikes, with the three forks running along two rails. Primary kickstarting was used, although the advantage of being able to start in any gear was lost somewhat by the need to follow a well-defined procedure in order to get the XT to light up.

The frame of the XT was different from its contemporary Yamaha dirtbikes. The large-diameter backbone and single front downtube supported the headstock with the usual gusseting between the two. At the bottom of the engine, two frame rails joined the downtube to form a cradle for the engine and passed up to support the rear subframe. Behind the engine, two more tubes tied the cradle to the lower end of the backbone tube. Bracing was provided between the cradle rails under and behind the engine as well as for the rear subframe at the join with the cradle tubes. Since it was expected to spend most of its time on the street, stability was provided by a fairly slow 30·5-degree rake and a 1420 mm wheelbase. A bash plate was bolted under the engine to protect the crankcases from rocks when out on the trail, but it was too short, ending halfway along the engine. The circular section rear swinging-arm was mounted on roller bearings and had a grease nipple tapped into the pivot support to simplify regular lubrication. With the tall engine block, there was no way that the monoshock design of the time could have been used on the XT. Instead two Kayaba gas/oil rear shock absorbers were mounted at a laid-down angle of about 45 degrees. Only spring preload could be adjusted, with a choice of five positions available. The front forks were of the same design as those fitted to the MX models providing 195 mm of travel, but 2 mm thicker in diameter. Double pinch bolts on the steering stem held the forks in place.

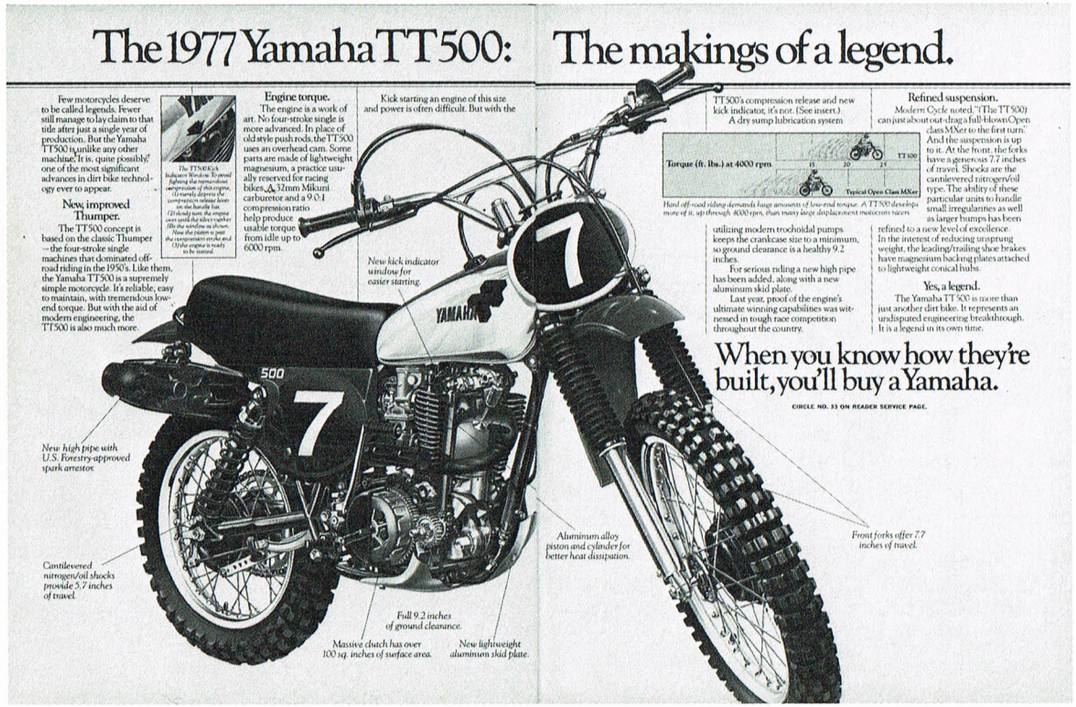
Wheels and half-width brakes were very similar to those on other Yamaha dirtbikes. One improvement that was made was the use of thicker rims, which although heavier, and unsprung as well, were a lot stronger than the MX rims which were easily dented. The left-hand side panel was lockable with the battery box and a small waterproof pouch hidden behind it. Cleated footrests ensured optimum grip for even the muddiest boot and no passenger footrests came as standard equipment. Full street equipment was provided, including a headlight, taillight, traffic indicators, two mirrors and both speedometer and tachometer. Finished in the styling common to the XT, DT and MX series in 1976, the 500 had a white tank with red sidewalls and a wide black stripe passing over the tank from side to side. White lettering on the black stripe recorded the capacity and the marque name. On the side panels the XT series identification and enduro function of the bike was proclaimed.

The press and the public loved it. It represented everything the British thumpers should have been and weren't. The engine had bags of torque from 2500 rpm right up to its maximum engine output at 5500 rpm. Off-road it could climb almost anything as long as the tyres hooked up, the smooth power delivery making it very easy to ride. It was a little less happy at high speed, since the suspension was not quite



Left **Inevitably, wheelies were the XT500's forte, but the suspension was inadequate for any hard dirt riding**

Below **Yamaha were right about the legend**



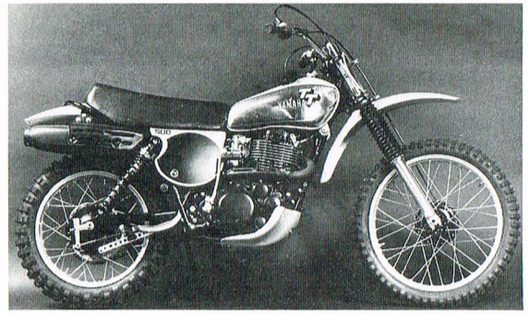
so competent as the engine. The front end was too soft and the rear end too hard for high-speed dirt riding. Also the semi-knobbly tyres were not perfect for either dirt or street riding. When on the street, the suspension problems disappeared and the XT500 was simply the best dual-purpose bike available. Somehow Yamaha seemed to have ironed out all the vices with which the British thumpers had been cursed. Vibration was low, the engine was oiltight, it was easy to start, if the correct procedure was used, and above all, it was reliable. As far as the XLs were concerned, with 30 per cent more torque and 20 per cent more power than the 350, it would eat them for lunch. With the high gearing, it was possible to screw a maximum speed of 90 mph out of the engine and it had enough grunt at any speed to easily pass four-wheel traffic. The rear brake was a little too sensitive and in fact this contributed to the only real criticism of the power unit. The deliberate use of lighter flywheels meant that the engine revved easily, but it was possible, when using the toggle rear brake in the dirt, to stall the engine. A more progressive rear brake would have solved the problem, but it took some time in coming. Yamaha had produced a winner with the XT500C.

The XT was not alone in the Yamaha's range of four-stroke dirtbikes for 1976. A stripped-down XT was offered for pure off-road use and was known as the TT500C. Identical engine units were used, with a lower final drive bringing the ratios down to a more suitable figure for off-road use. The chassis was of the same design, but with as much weight trimmed as possible. This, coupled with the loss of roadgoing electrical equipment, resulted in a weight saving of 15 kg. Despite this, the TT500 was not a serious enduro mount in standard trim. Increased engine performance and revised suspension were necessary to make it fully competitive. It would be expensive but there were some prepared to pay in their commitment to four-strokes.

With such a successful first shot at the concept of the big thumper, it is not surprising that few changes were made to produce the D model. Clearly with their ear to the ground, it was the chassis that was given the most attention by the Yamaha development engineers. The same frame layout was used, but the rake was pulled back one degree to quicken the steering. This was only of real use for the off-road ventures into tight-track woods, where the heavy four-stroke could prove to be a bit of a handful at low speeds. The front forks were updated with many components from the IT series, including longer springs, and gaiters were added to protect the sliders. At the rear end, new Kayabas provided another 20 mm of rear wheel travel with revised damping characteristics. All the electrical equipment was mounted on flexible rubber stalks, to restrict the damage when dropping the bike in the dirt or riding a narrow trail. The aluminium engine skid plate was extended up and further behind the engine, protecting the sump completely.

Few changes were made to the engine. Most important for the rider was the provision of a small inspection window in the cylinder head. This was to assist with starting the XT. The compression-release lever was depressed and the engine carefully turned over until a silver disc appeared in the window. The piston was now in the optimum position for the engine to be started. A hefty kick would normally result in the bike firing up. If not, the procedure just had to be repeated. Rather ominously, the kickstart lever itself had been strengthened! A new exhaust was routed above the engine cases, inside the first frame tube, outside the second and up along the rear of the bike. The new exhaust and rejetted carburettor resulted in a slight top power gain, but this was unnoticeable when riding.

The TT500D and XT500D were as close as ever, although the frame of the TT had a 30-degree rake and the lighter front wheel and brake from the IT400C were fitted. Both bikes were improved



by the update and the XT in particular maintained its position at the top of the dual-purpose motorcycles.

1977 was also an important year for the XT/TT 500 on the GP racetracks of the world. Amazingly enough a four-stroke machine was once again a competitive force in the world of 500 cc GP racing and the irrepressible Torsten Hallman was responsible for getting it there. The story goes back to the ISDT in October 1975, held on the Isle of Man. American Gary Surdyke had brought

Above **The TT was really in its element out in the wide-open spaces of the desert, where the fantastic torque of the machine could be given full rein**

Top **The TT500D had changed a little from the previous model, with quicker steering and an IT front wheel**

Right **Gary Surdyke gave Europeans their first sight of the new XT500 at the Isle of Man ISDT of 1975, before selling the bike to Torsten Hallman, who turned it into the famous 'factory' HL500**

a prototype XT500 with him to compete in the event. Although attracting a lot of attention from the public, the XT was clearly not suited to the rigours of ISDT competition and expired on the third day. In Sweden at the beginning of 1975, Hallman had heard of the forthcoming arrival of the XT in the US and an idea had begun forming in his mind of producing a competition version. When he approached Japan, he had been told that the XT would initially not be available in Europe and he would not be given a model on which to develop his idea. On learning of the XT500 in the ISDT, Hallman located Surdyke and bought the machine off him. So in October 1975, Hallman had the only XT500 in Europe.

The project was adopted by Sten Lundin, then service manager with Hallman's Yamaha importation business. It was, however, treated more as a hobby than a serious development project and was worked on in the evening and at weekends. Initially, work concentrated on the chassis and the engine was slotted into a far lighter Husqvarna frame. This frame was used as a basis for designing an original frame which was drawn up by Lundin and manufactured by Profab in California. A special aluminium swinging-arm was fabricated and US Fox shock absorbers were used in place of the unsophisticated Kayabas. Later these were themselves replaced by shock absorbers manufactured by a new Swedish company called Öhlin. With ready access to YZ spares many of the original items were replaced by the motocross equivalents. Hence the latest YZ forks were used on the front suspension. The total wheel travel at both ends was to become 250 mm. YZ wheels and hubs were also pressed into service and as it seemed likely that the bike would be entered into the GPs in 1977, engine plates, nuts and bolts were replaced by duraluminium items. In the end the HL500, as it was named, weighed in at 102 kg, 25 kg lighter than the TT500.

Work on the engine was left to four-stroke tuning expert Nils Hedlund. He restricted himself

Left **The HL500 as it was announced to the world at the start of 1977**

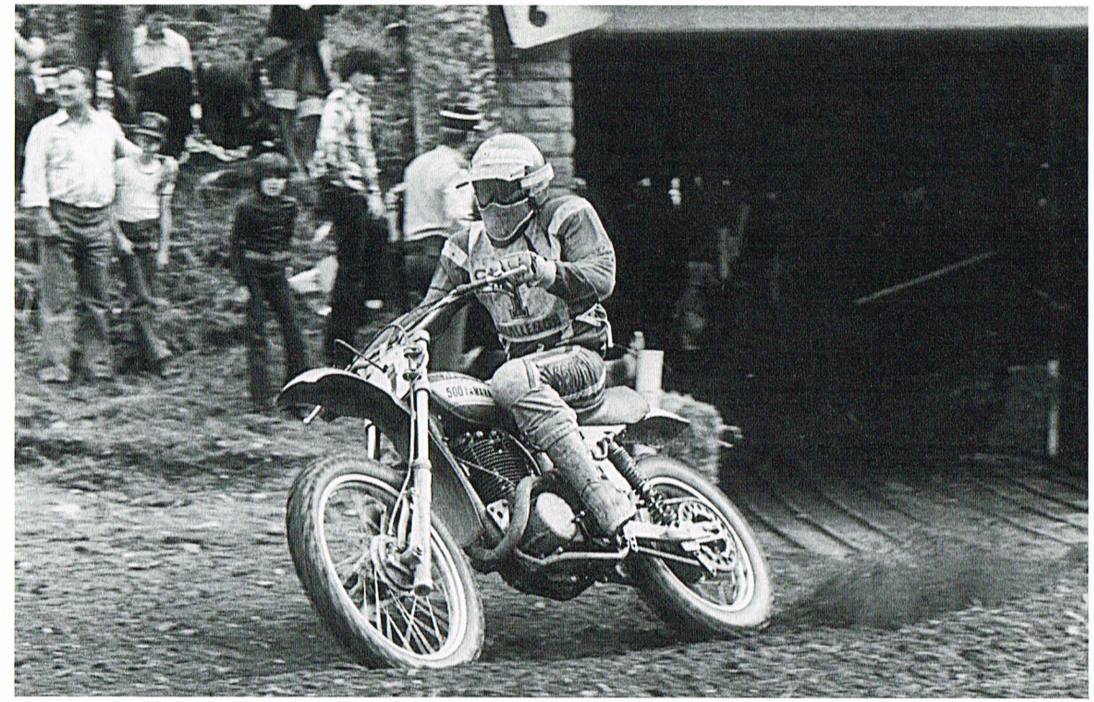
Right **By the second GP of 1977, the Fox shocks on the HL500 had been replaced by Öhlins**

to giving the engine a mild tune-up and reducing the weight as far as possible. A lighter YZ250A clutch replaced the massive 15-plate XT item. The ignition from the MX125 saved 1·5 kg alone. The crankshaft and gearbox were not touched, but the cylinder head and piston were altered to give an 11:1 compression ratio instead of the standard 9:1 of the TT. The carburettor grew from the 34 mm to a 36 mm Mikuni.

As the development slowly progressed during 1976, it became clear that what was emerging was not just a reworked TT, but a serious motocross machine. The excitement grew as Lundin and Hallman began to realize that it might just be competitive enough to do the GPs. Four-strokes had long been discarded as top-notch GP machines, despite the continued presence of the CCM of Alan Clews, that had grown out of the ashes of the BSA motocross machines of the 1960s. The CCM was never a front-runner in the world championship 500 class, only occasionally picking up points in the lower places. This would not be good enough for the Yamaha. If it was to compete, it must be capable of finishing well. Hallman and Lundin gradually became convinced that it could.

After Yamaha reconsidered their decision not to import the XT to Europe, it was obvious that an XT clone competing in European GPs would be an excellent way of publicizing the new four-stroke's arrival in Europe. With a carefully itemized budget, Hallman approached Yamaha in Amsterdam with a request for backing to the tune of $15,000. After initial hesitation he got the green light to run a small team in 1977 with veteran Bengt Aberg, winner of the 500 cc title in 1969 and 1970, riding the bike. To get the agreement Hallman had made what he, at the time, considered a rather rash promise that the HL500 would finish in the first five places at least once during the season. His faith in the bike was to prove well founded.

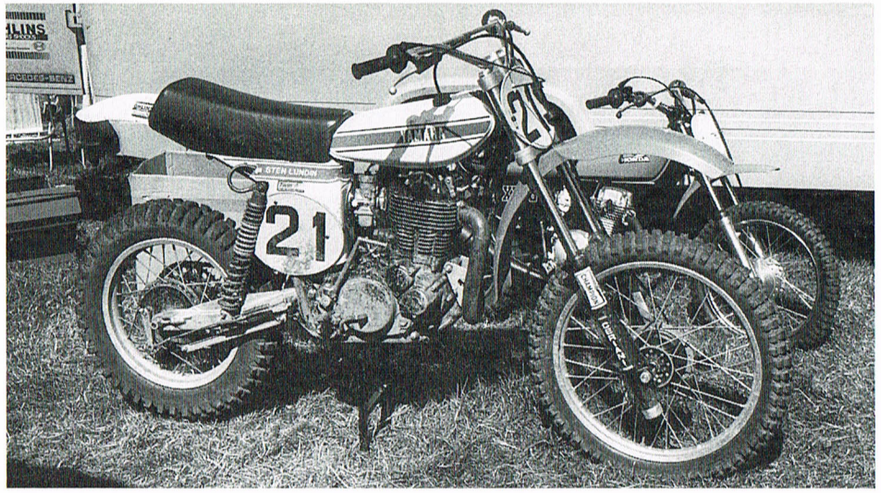
In the first GP of 1977 in Austria, a puncture brought a DNF in the first moto but an encouraging eighth place was the result of the second race. There followed a string of engine failures at the next three GPs, in the Netherlands, Sweden and Finland, which left the team rather despondent. However, a superb race in Germany brought Aberg a 3rd place in the first race, but he was brought down by another rider in the second. Hallman's promise had been kept and it was still only mid-season. In the USA, the engine blew a head gasket in the first moto while Aberg was in 8th place with a single lap to go. The gasket could not be replaced in time for the start of the second race. A week later in Canada, Aberg's luck was out with DNFs in both races. Back in Europe Bengt repeated his German result in the UK, with a 3rd place in the first heat and a fall in the second. Ceriani front forks had replaced the YZ suspension by now. There followed a three-week break before the next race in Belgium, where a puncture put Aberg out of the first moto but he claimed 7th place in the second. Luck had not been on the team's side during 1977. Then on to the penultimate GP of the season in Ettlebruck, Luxembourg. In the first heat, Bengt went straight into the lead and after



an initial battle with Hakan Andersson on a works Montesa, which ended as the Montesa faded, remained unchallenged to the end. This was the first GP moto win by a four-stroke for eight years and probably the last ever. In the second race Aberg made a slow start but pulled up to third place to tie on points with Mikkola. Unfortunately Mikkola posted the better time and so took the overall victory, but the moral victory lay with the small Swedish team. They had achieved the impossible, turning the pages of history back eight years and given the supporters of the four-stroke something to cheer. It was a truly historical event.

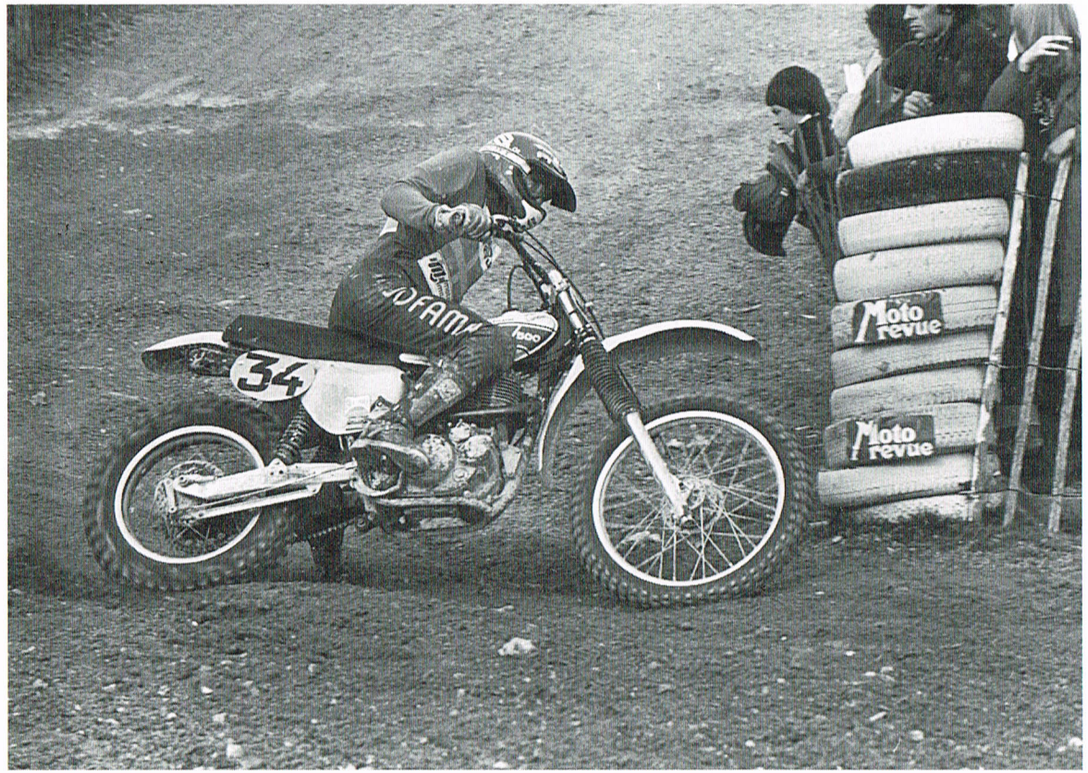
Sadly factory development support was not forthcoming in 1978. However Hallman and Lundin were so encouraged by the result in Luxembourg that they decided to employ Hedlund to develop a three-valve head for the bike. Despite the resulting power improvement, the four-stroke Indian summer of 1977 was not to extend to 1978 and after a year of disappointing results, Hallman decided that there was no future for a four-stroke in world championship motocross and the team was disbanded.

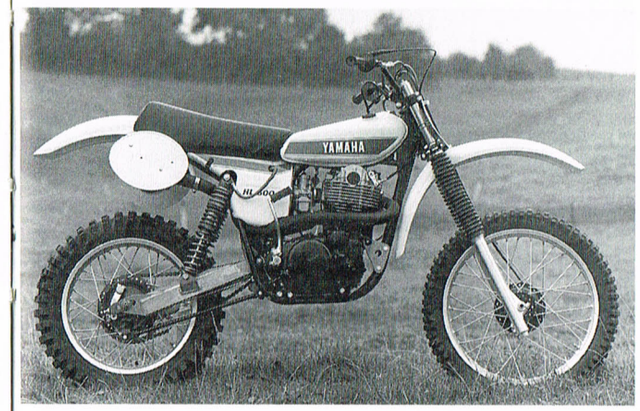
The success of the bike in 1977 had aroused sufficient interest for Tanaka, European Yamaha motocross team manager, to decide to produce a limited run of replicas to be sold in Europe. Aberg's spare machine was handed over to the remaining small Norton factory at Shenstone in the UK with the instructions to build 200 replicas. For the first year of production of the HL500, a lightly modified TT500E engine was fitted into a chassis identical to the one Aberg had used during 1977. Experience showed that it was underpowered and very difficult to start. For 1979, 200 more were built with a new camshaft, CDI igni-



Left **Ceriani forks were in use by the British GP mid-season 1977, where Aberg took third place in the first race**

Below **Aberg on the three-valve 1978 factory HL500 at the French GP where he finished ninth in both races**





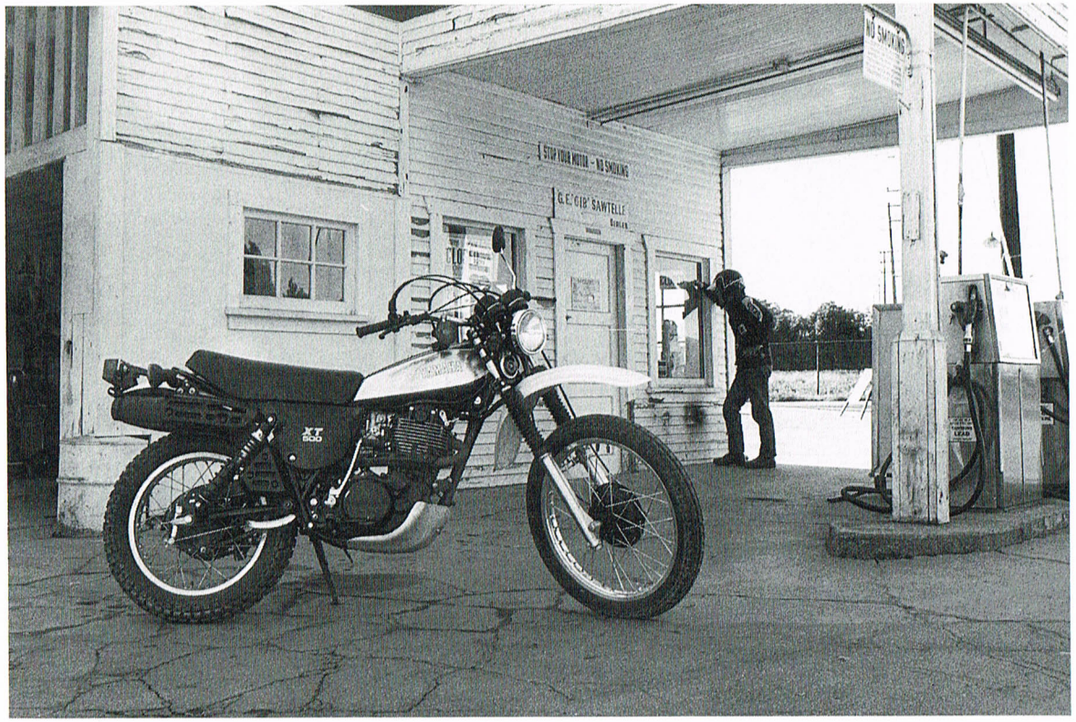
The 1979 version of the production HL500 of which only 200 were produced.

tion from the SR street-going brother of the XT and a larger 38 mm carburettor. This, coupled with a new exhaust pipe, raised the power output significantly. The design of the swinging-arm changed slightly with the mounting for the external reservoir shock absorbers moved forwards to the pivot axle. Rear wheel travel increased to 260 mm. The front suspension was taken from the YZ250F of that year, which had a total of 270 mm of travel. A number of other parts from the YZ250 found their way on to the HL, including the rear brake and its tie rod. No more HLs were made after 1979. They were too much hassle to produce in quantity local to Europe and as the memory faded of Bengt's victory in Luxembourg, so too did the demand.

It was pretty difficult to find any differences between the XT500E and XT500D. There were a few but they were minor such as a stronger drive shaft in the transmission, revised damping for both front and rear suspension and of course new decals to ensure that the customers were aware that a 'new' model was available. It was even more difficult in the transition from E to F at the end of 1978, as there were no changes. The XT500E and XT500F were the same machine, with once again a cosmetic update. Twin brother, the TT, marked time in the D to E transition but received a little badly needed attention for the F model.

The chassis was beginning to look and feel decidedly dated and for what was billed as a pure dirtbike was really rather poor. A new frame was produced which was claimed to be lighter and with a 0·5-degree steeper steering head. Leading-axle front forks were used for the front suspension and the handlebar mounted further back to allow the forks to be moved up and down the triple clamp to suit the rider. Strangely enough, suspension travel was not increased. At 195 mm it was inadequate for the heavy machine. And it was heavy, since the reduced weight of the new frame and aluminium rear swinging-arm, were exceeded by the extra weight of the front forks. The operation of the rear brake was improved by the use of a single rod between lever and brake as well as a repositioning of the brake cam lever. This had previously pointed down and was easily damaged on a rough trail. The new vertical position kept it out of harm's way. The brake tie rod was eliminated by the adoption of the tongue-in-groove brake backing plate that had been used on the motocross models for a couple of years. Dog-leg handlebar levers were provided and the tips of the gear and brake levers folded. Only engine change was the provision of a hot starting lever on the carburettor that when depressed, raised the slide a fraction and leaned out the mixture. It didn't seem to help much since starting a hot TT was as hit-and-miss an affair as it had always been.

Despite the improvements, the TT500F was not a good dirtbike. The chassis was just not able to match the power of the engine. Suspension was not supple enough to absorb stutter bumps and the front wheel had a tendency to washout. Whoop-de-doos would have the TT500 wallowing like a pregnant hippo and the excess weight made it very difficult and tiring to control. It was only on high-speed fireroads that the TT500



Above **By 1980, the XT500G was beginning to look like a dinosaur that technology had passed by**

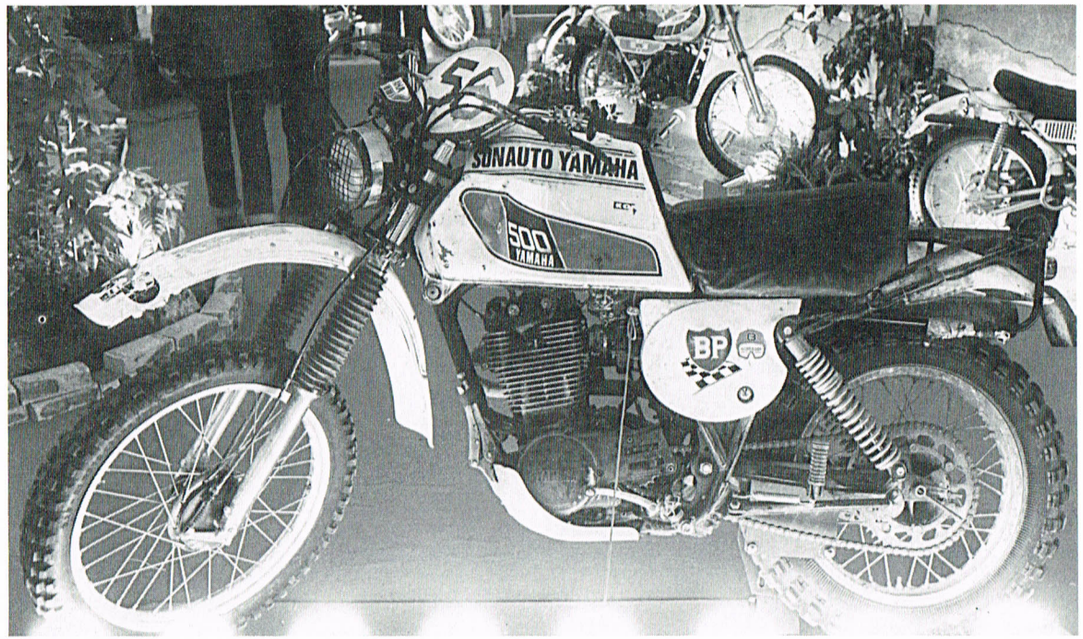
Left **The completely new XT250G with its monoshock chassis promised greater things for the complete XT range, but they took some time coming**

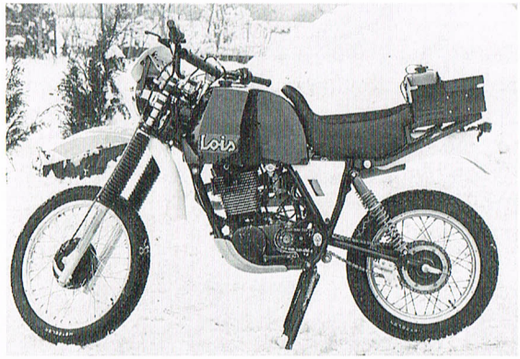
excelled, where the fantastic engine could let rip and haul the bike along at exhilarating speeds. With big-bore four-strokes now available from Suzuki (DR370) and Honda (XL500), the Yamaha seemed to have lost some of its charm and many found the Honda a better machine. Yamaha needed to review the XT and TT very carefully and make some big improvements if they were to retain their title as King of the thumpers.

None of the hoped-for improvements manifested themselves on the 1980 G models. The TT500 was left unaltered and the XT received a few minor improvements. Some of the components of the street-only SR500 were used in the engine to raise the overall power output. The inlet valve was 47 mm in diameter—2 mm wider than the one previously used. In the US an accelerator pump was fitted to the 32 mm Mikuni to help the low end by enriching the mixture flowing into the engine. The US models also got the benefit of a CDI ignition to replace the old points-driven ignition. Only some of the chassis improvements made to the TT500F were carried through to the XT500G. The rake of the frame was again steepened, ending up now with a quick 29-degree steering head angle. This was, in fact, an attempt at improving the slow-speed handling in the dirt that was compromised in fact not so much by the steering geometry as by the weight of the bike. With the new frame, the rider got the worst of both worlds, with a front end that was as imprecise as ever and now twitchy to boot. Leading-axle forks were lifted from the TT, but the rear end remained unaltered. Despite these changes, the riding characteristics of the XT were not improved. The extra power could be noticed but had hardly been necessary while the chassis modifications reduced the XT's off-road suitability. The XT seemed to be heading down a blind alley that could only lead to extinction as better (read Honda) machines became available.

Fortunately there was one bright spot in the four-stroke series for 1980 and that was the new XT250G which everyone took to be an indication of the direction Yamaha would be taking with the XT development. Rather than produce a shrunk version of the 500, Yamaha started more or less from scratch and designed a new four-stroke engine and chassis. With a short stroke of 56·5 mm and a bore of 75 mm, the 250 would be able to rev quite well and indeed its redline was marked at 7500 rpm, although it would go up to 8000 rpm before the power signed off. A two-valve head was used with a plate on the left-hand side through which the camshaft and rocker arm could be loaded. The camshaft was driven by a chain on the left-hand side of the engine and a ball bearing was used to support the camshaft of the drive side while a roller bearing was considered adequate for the other end. A compression-release mechanism was fitted, but in contrast to the lever-operated version on the 500, this was connected to the kickstart lever and automatically operated as the bike was started. On the first batch of XT/TT 250s, the mechanism quickly failed, leaving the exhaust valve open and the engine thus inoperative. Fortunately the 250 was an easier starter than its big brother so the mechanism could be disconnected until Yamaha came up with a service update.

The bottom end was of conventional design with full-circle flywheels and, as on the 500, a plain copperized bearing at the little end. When the XT500 had been introduced in 1976, the lack of vibration had been welcomed by all. However, everything is relative and they were welcoming the lack of vibration in comparison with the mind-numbing vibration produced by BSA and Matchless machines of a bygone age. On the 500s the vibration level had become increasingly irritating as each new model arrived and no improvement was noticed. On the 250 a counterbalance weight was driven from the crankshaft to produce an almost vibration-free engine. The clutch was of the same design as that of the larger XT, although only 11 plates were





The XT500 was also the mount of the intrepid African desert racers at the turn of the decade. *(Top)* **was entered by French Yamaha importers Sonauto in the 1977 Rally Afrique and** *(above)* **was a private entry for the 1981 Paris-Dakar race**

Above right **At last 1982 brought a revision to the top of the XT range, with the introduction of the XT550**

considered necessary to transmit the lower power to the gearbox. Ball bearings were used to support both ends of both shafts in the five-speed transmission and as on all Yamaha dirtbikes, the XT250G could be started in all gears. A wet sump was used for the lubrication of the engine, since the new chassis design made it difficult to use the backbone of the frame as an oil reservoir and the highly placed weight of the oil would have a detrimental effect on the handling of the bike. A trochoidal pump on the right-hand side of the engine driven via an idler gear from the crankshaft ensured the lubrication of the engine through internal oil passages. An upswept exhaust pipe passed along the right-hand side of the bike and was capped by an enormous muffler that reduced the exhaust note to a whisper. The 28 mm Mikuni was also given an accelerator pump that was activated by the vacuum in the inlet tract. CDI ignition was used with the rotor keyed to the left-hand end of the crankshaft. Several of the engine covers were moulded plastic to keep the weight down as far as possible.

While the engine was of a completely new design there was little to see of this externally. The use of a monoshock chassis design was plain to see. At last the XTs were joining the trend set by the YZs, ITs and DTs. In order to position the engine low enough to make room for the monoshock damper, a new frame design was made. The single downtube was retained, but there was no frame cradle, the engine itself being used as a stressed member. A very short large-diameter backbone was used, from the end of which two rails dropped down behind the engine. Very thick engine-mounting lugs were welded to the inside of the rails and a rigid box structure held the front of the engine. A conventional rear subframe design was used with a rail loop attached to the main frame tubes just below the backbone joint and supported by two tubes running up from the back of the engine. Bracing was present between the backbone and front downtube as well as between the main frame and subframe tubes. Rake was set at a quickish 29 degrees.

A circular-section, double-fork swinging-arm was fitted according to the usual Yamaha design. The upper mounting point of the rear shock absorber was the lower end of the frame backbone. Only spring preload could be adjusted on the steel-bodied De Carbon damper and this required the removal of the petrol tank. Leading-axle forks were provided up front with 205 mm of travel and 35 mm diameter stanchions. The rear wheel was a 17-incher instead of the usual 18-incher, which combined with the monoshock design to give a very low seat height. The rear wheel was not QD but it did use snail-cam chain adjusters. Brakes were of the usual single leading-shoe drum type fitted to most of Yamaha's dirtbikes.

The XT250G was a big step in the right direction. It was very light, some 5 kg lighter than the class leader, the XL250 of Honda, and had a good powerful engine. The chassis itself was also a lot better than the old XT500 design, but a common Yamaha failing was also experienced on the quarter-litre machine. The suspension was much too soft as standard. Unfortunately no alternative springs were offered so it was left to the after-sales companies to sort out this problem. Gearing was just right for the dirt but a little too low for the street. In fact, the whole bike seemed to have been designed with the dirt in mind and consequently functioned there very well.

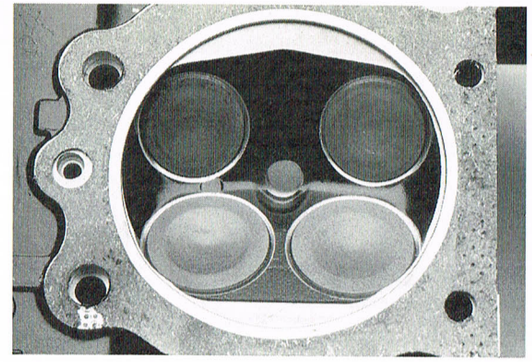
A TT250 was also offered with a few differences from the XT. A 30 mm Mikuni replaced the 28 mm item on the XT and the compression ratio was raised a little. Lower overall gearing was achieved by an extra four teeth on the rear wheel sprocket. An extra 25 mm of suspension was available at both ends and the stanchions on the front end were 1 mm thicker. Unfortunately the springs at both ends were unchanged and therefore too soft to enable the performance of the bike to be used to the full. Despite this the TT took the title of class leader over from the XL250R.

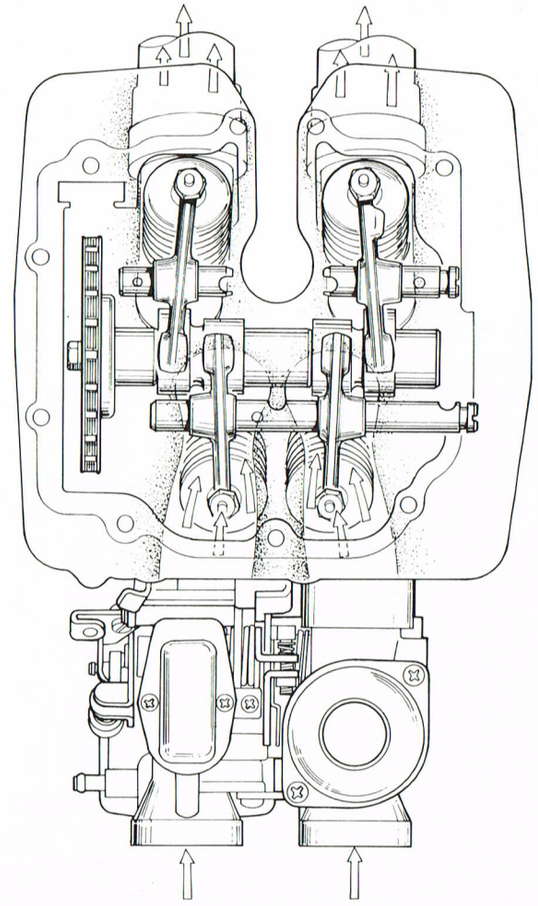
The appearance of the XT and TT 250s with a new chassis warmed the hearts of the XT and TT500 aficionados as it looked like at last their prayers for an improvement would be answered in 1981. There was even some delay in revealing the new range of four-stroke machines for that

year and this fuelled the speculation that at last a major update would be made to the big machines. When at last the XT and TT H series was revealed, they could hardly believe their eyes. All models were unchanged. The XT500H and TT500H were identical to their G equivalents. Speculation now turned to a rumoured desertion of the big four-stroke class by Yamaha, since no one in their right mind would buy an H model with far better machines available. Sadly the vanguard of the thumper resurrection, so praised and admired in 1976, seemed little more than a bad joke five years later.

Exactly what went went wrong in 1981 is now difficult to determine, but it seems certain that production of new models was delayed by a hitch somewhere along the line. Thankfully, the mistake was rectified a year later as the J series was announced with an upgrade big enough to cause a flood of ex-Yamaha devotees rushing back to the fold. The range of XTs was even extended, with a 125 and 200 being introduced. This baby of the line-up was modelled very closely on the XT250, with the same engine configuration and frame design. With short-stroke engine dimensions of 57 × 48·8 mm, the 125 revved up to 9000 rpm to produce its maximum power of 12 bhp. A seven-plate clutch was felt adequate to transmit this power to the gearbox. One significant difference from the 250 was the use of a steel box-section swinging-arm painted silver to give the impression that it was a lightweight aluminium item. Even without the trick parts, the 125 was light with a dry weight of just 98 kg. This made it easy to flick about in the dirt and for once it was the engine that could have been a little better, the 12 bhp proving inadequate in some situations. The XT200 was simply a bored-out 125, sharing the same chassis and transmission.

Surprisingly the 250 did not share in the general update that took place for the J series. It didn't even get the new rear swinging-arm fitted to its smaller brothers. It would have to wait





Top left **Four valves were introduced on the XT550 in the need to be seen to be employing the latest technology**

Bottom left **The YDIS dual-carburation system that was supplied on the XT550**

another year for the big change. This was not true of the 500, which grew 50 cc, two valves, another carburettor and a monoshock chassis. At last a complete redesign. Yamaha engineers might have been tempted to leave the engine alone when designing the new bike, since it had never been a real problem on the 500. But this was not to be. The company was anxious to shrug off the 'Stone Age technology' label many had hung on the big XT and a radical new engine design would certainly achieve this.

Only a few of the features of the XT250 were to be found on the new engine. One of these was the repositioning of the camshaft drive to the left-hand side of the engine and the use of a Hy-Vo chain in place of the normal linked chain. The camshaft turned on plain bearings in the aluminium head instead of the ball bearings used on the old 500. A single cam with four lobes drove the four-valve head, necessitating a rather unusual design, with the inlet valves very close to each other and the exhaust valves forced apart. Twin header pipes were fitted to receive the exhaust gases. Both intake valves were 36 mm in diameter and offered a 50 per cent increased flow area over the old single 47 mm XT500 valve.

Even more unusual was the fact that each valve was fed by its own carburettor. Known as YDIS (Yamaha Dual-Intake System), a slide carburettor fed the left-hand and a constant velocity carburettor the other, with fuel coming from a single float bowl on the slide carburettor. The two were linked in such a way that only the slide carburettor was operational up to half-throttle openings and then the CV carburettor kicked in to help. The theory behind this design was to provide an increased overall carburettor intake diameter without the problems of low engine speed metering associated with single large carburettors. Each unit had a diameter of 26 mm, meaning at the small throttle openings the charge would be correctly metered in response to the lower intake air velocity. As the engine speeded up, the intake air velocity would increase and the second carb would open to provide the extra charge, linked through its CV operation to the intake manifold pressure. A rather complex but clever system.

The larger capacity of the engine had been obtained by boring out the XT cylinder to 92 mm and retaining the old 84 mm stroke. Compression ratio dropped a little, but both maximum torque and power were substantially increased. As on the 250, a balance weight was added to reduce vibration that had been excessive of the old XT500. The CDI ignition flywheel was keyed to the left-hand end of the crankshaft and the complete electrical system uprated to 12 volts. In contrast to the 250, a dry sump lubrication system was retained with the frame still doubling as oil reservoir. Although new components were used, the general design of the transmission was not altered. The primary drive was via helical gears and the overall ratios were altered very slightly. The same automatic compression-release device was fitted to the kickstart pedal, as had been perfected on the 250, resulting in the raising of the right-hand exhaust valve during the initial part of the kickstart lever's throw.

The frame design was essentially the same as that of the 250, but with a much larger backbone member to contain the oil for the engine. The rake of the frame was once again pulled in a degree bringing it down to 28 degrees but the wheelbase was essentially unchanged. Strong 38 mm forks were used for the front suspension and they gave a total of 205 mm of travel to complement the 190 mm possible at the rear end. Brakes and hubs were of the same design, but alloy rims were used to keep the unsprung weight down. In fact it was quite a success story

as far as weight was concerned, since despite all the extra hardware, it dropped by 1·5 kg, although the XT was still no lightweight. Since Yamaha had decided not to introduce a TT550J, the possibility of the bike being used for more adventurous dirt riding was encouraged by the provision of QD street equipment. The complete instrument panel and front light assembly could be removed as a single unit.

As with the old XT500 series, the overriding virtue of the 550 was its power. Only the newly arrived and expensive Rotax-powered enduros were faster. The YDIS system seemed to work well, although some testers detected a mid-range glitch as the CV carburettor came into operation. Unfortunately, it looked like the XT550 would once again have to rely on its power for sales, as the chassis, while better than before, was not adequate for off-road riding. The lack of a TT model led many to consider the XT to be more than it was. When ranged against the more serious enduro four-strokes, its shortcomings were obvious, as recorded in a *Dirt Bike* 'Shootout' dating from 1982. A few comments are such gems that they deserve recording for posterity. Referring to the ability of the XT to turn: 'It turns like a boat. A long boat dragging a net full of bowling balls'. How about high-speed stability? 'Several testers got religion as they grappled the XT down from speed. One tester commented, "It was a lot like mud wrestling a 300-pound carp".' Finally, ease of riding: 'It lumbered across the landscape like a giant crab and pounded the rider . . . even at trailriding speeds'. You had to give credit to these guys, they certainly knew how to put a bike down.

Not too much changed for 1983. The 125, 200, 250 and 550 were all identical to the previous year's machines, except for the odd decal. Good news for a lot of people was the reintroduction of the TT model and even better news was the extensive update it had undergone. The cylinder of the 550 was bored out to 95 mm and now displaced 595 cc. In fact the cylinder was of a new design using a chromed aluminium liner instead of the usual steel liner. With the lower chance of seizure in comparison with a two-stroke, the new surface could be safely employed, without the risk of having to junk the cylinder. At the top end, the exhaust valves were 1 mm wider and a new camshaft had longer duration. A total of 4 kg was saved from the new cylinder, the crankshaft assembly, the use of a magnesium clutch cover and an aluminium kick-start lever. The engine oil was no longer carried high up in the frame tubes, but in an oil tank located behind the engine.

The chassis was based around the fifth generation of monoshock design. The same frame design was used as before with the engine acting as a stressed member, but the size of the backbone and front downtube was reduced now they no longer had to store the engine oil. Steering head rake was identical to that of the XT at 28 degrees, but the wheelbase was 85 mm longer. The most significant difference between the two chassis was to be found in the suspension. Full 43 mm diameter Kayaba forks were lifted from the YZ series where they had been found to be totally flex-free. A massive 270 mm of travel was provided, comparable to motocross standards. Tuning of the front suspension was possible due to the provision of air caps on the forks. The rear end appeared to have been lifted directly off the IT490K, and as far as Yamaha was concerned it was state-of-the-art technology. In fact the extruded aluminium swinging-arm was 25 mm shorter and the rear suspension leverage ratio was more progressive than that found on the IT. Stopping power was improved up front by a twin-leading-shoe drum brake straight off the large capacity IT and YZ models. There was no doubt about it. This was the major change TT aficionados had been waiting for.

The improvement over the last TT model, the TT500H, was enormous. Here at last was a serious four-stroke dirtbike from Yamaha. An extremely powerful engine, in a rigid frame that gave the

Monoshock suspension and an aluminium swinging-arm improved the XT550 enormously but it was not enough to put it back at the top of the tree

The XT600 Ténéré was introduced in 1983, in a successful attempt at cashing in on the Paris-Dakar rage that was sweeping Europe

Yamaha the quickest steering in its class, and fantastic brakes that brought the heavy bike down from speed without fuss added up to an excellent all-round package. Inevitably there was one slight deficiency that spoiled the TTs score sheet. The suspension was too soft at both ends. This was a failing that was continually occurring on Yamaha dirtbikes at the start of the eighties. No matter how often it was reported, Yamaha turned a deaf ear. Despite this flaw, the TT600 was the best four-stroke dirtbike of 1983 and it was good to see it at the top after so long away.

In Europe in 1983, an XT600 special was offered for sale alongside the XT550J. It was known as the XT600 Ténéré and was produced at the request of the French importer Sonauto, as a replica of the XT500/600 machines that had been entered in the Paris-Dakar desert race since its inception in 1979. Yamaha had won the first two of the annual races and finished well in the following two, and the 10,000 km race over a two-week period had attracted enormous publicity in Europe and in particular France. The new XT600 turned out to be a cross between the XT550J and the new TT, although the changes made to the TT to reduce engine weight were not included. In particular, the larger exhaust valve, exhaust pipe and higher primary transmission ratio were fitted as well as a lower first gear. A small oil cooler was clamped to the left frame member behind the engine. The same frame design was adopted but a compromise was made with the suspension by using 41 mm Kayabas up front with 250 mm of travel and a Mono-cross rear end with different linkage giving less progression as the TT600.

Two features of the chassis were particularly eye-catching. The first was the massive 30-litre petrol tank perched on the top of the machine, which would have done terrible things to the handling if the Ténéré had ever ventured on to the dirt with a full tank. Secondly a 225 mm diameter disc brake was mounted on the front wheel to stop the heavyweight monster. A so-called safety seat overlapping the seat/tank join was pinched from the motocross and IT series, where it was important to be able to move easily around the bike. It was a little superfluous on the

big XT. Finished in white and red, or Gauloise blue, the XT600 Ténéré couldn't fail to make an impression and that is exactly what the thousands of boulevard posers wanted. The Ténéré was the street scrambler of the 1980s.

In the general shakeout that occurred during 1983 throughout Yamaha's dirtbike range, the 125 and 200 disappeared from most markets, although Australia continued to receive the XT200K. Some of the 600 design was fed back into the new 250 which received the dual-carburettor YDIS set-up with 22 mm diameter throats. Most significant engine change was, however, the move to a four-valve head with double overhead camshafts driving them. In place of the screw tappet adjusters previously used on the 250 came inverted buckets and shims, so maligned by the home mechanic for the complication they add to routine maintenance. The move to four valves turned the 250 into a revver, with a redline at 9000 rpm. In order to keep the 250 on the boil, meaning above 7000 rpm, a six-speed gearbox was added, closing down the gaps between gears in the process. No other changes were made in the engine design and the mill was slotted into a smaller version of the TT600K frame. Kayabas of 35 mm provided 250 mm of travel at the front and the single Kayaba damper at the rear, 220 mm. Both ends were too soft and under hard braking the 250 mm of fork travel shrank to almost 0 mm. Not only were the springs too soft, but the damping characteristics were way off. Yamaha really had problems setting up suspension. The engine was too peaky for a dirtbike, even a dual-purpose dirtbike, since the engine needed to be kept up at the top of the rev range to produce any reasonable acceleration. It was a nice try, but the Hondas were better.

Of the 600s, the Ténéré and the TT were left untouched for 1984. Logically, the 550 was replaced by a 600 version, having much in common with its two capacity brothers. Ninety-five per cent of the engine was borrowed from the TT600, the only significant difference being a slightly milder cam profile. The design of the chassis was also very similar to the TTs, except 41 mm Kayabas were 2 mm smaller than those on the TT and a different damper was used on the rear end. Total suspension travel was lower than on the TT. In contrast to the TT, the XT wore a drilled disc on the front wheel, distinguishable from the slotted version fitted to the Ténéré. The move towards a cosmetic similarity with the YZ models was marked by the provision of air shrouds under both sides of the tank, ostensibly directing air towards the head to assist cooling. This was also used on the 250 and gave the false impression that the bikes were water-cooled. The XT600Ls performance could be described in exactly the same words used for the TT600Ks. Everything was fine except for the inevitable soft suspension. On the XT, with its street-riding priorities, Yamaha could partially be forgiven.

The winter's development time was not spent updating the existing XT models. The XT250N was unchanged and the 600s only got a few detail updates. Stiffer springs were welcome for the suspension and the TT600 gained a disc brake with a plastic cover to protect it from the worst of the dirt. The cover was also added to the other 600s. The CDI unit on the TT was moved into a cooling air flow by clamping it to the steering head. Yamaha figured that some of the starting problems experienced on the K and L models were caused by a hot CDI unit. That was about it as far as the existing bikes were concerned. The good news was the addition of another machine to the line-up, a 350 based on the 250 machine.

An uncharitable observer might have said that, after showing initial promise, the XT250 had turned out to be a dog. The peaky engine and soft suspension had ruined what could have been a well-balanced package. Yamaha's idea was to get some more power by enlarging the engine and slip it into the compact and light 250 chassis. Luckily the suspension was also on their

The XT600 was an enormous improvement over the 550 but too heavy to be used seriously in the dirt

list of improvements. There was more to the engine change than simply the fitting of a big-bore kit. Throughout the engine, components were strengthened to accommodate the increased power output. Extra plates were added to the clutch and new ratios used in the gearbox. The lubrication of the engine was given the once-over to ensure longevity. The crankshaft was increased in weight to provide greater flywheel effect. The chassis design was unchanged but the rake of the frame was steepened to 27·2 degrees. Although stiffer springs were fitted to the 36 mm Kayaba, they were still a little too soft as witnessed by the diving experienced under heavy braking with the front disc brake. Air caps allowed the forks to be tuned in to the rider's requirements. The new rear damper provided rebound damping adjustment supplementing the spring preload adjustment previously possible.

The XT350N was a very capable machine. With 24 bhp on tap it was 3 bhp more powerful than the XT350R, and coupled to the reasonable 132 kg weight it could put some mid-size streetbikes to shame on a twisty bumpy road. The suspension was a vast improvement over that of the 250 and its tunability enabled owners to get it to perform as well as could be expected from a dual-purpose machine. Thanks to the tight steering head, the 350 turned very easily, yet the straight-line stability didn't seem to be affected.

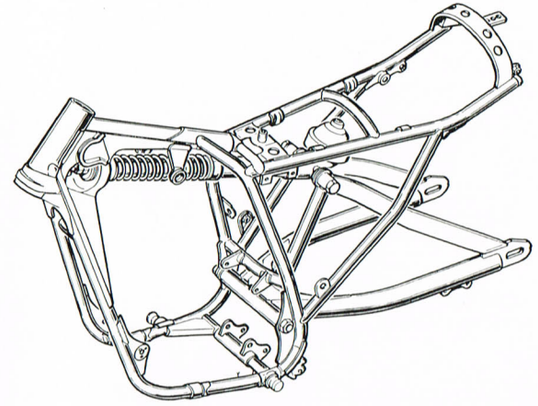
Many claimed that the XT350N was the best of all the Yamaha's XT series with its combination of light weight, and good power and handling

Its balanced package made it the best XT model of 1985.

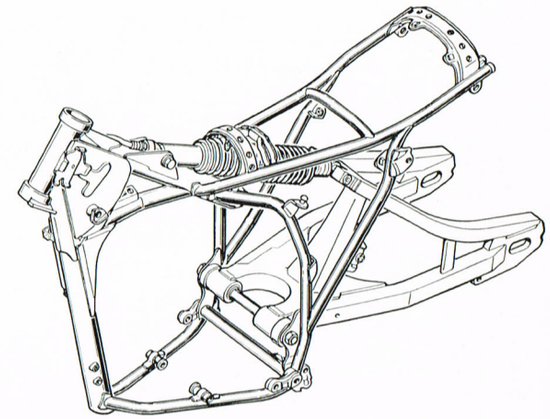
Ten years after the introduction of the first XT and TT models, the four-stroke dirtbike series was alive and well, confirming the soundness of the original concept. There had been good bikes and bad bikes produced in the intervening years, but the basic irresistible appeal of a large-capacity four-stroke single had always been strong enough to ensure the success of the series. At the outset of the development, a unique design had been introduced with very little in common with other Yamaha dirtbikes. Gradually, as the performance of the XTs in the dirt became more important, and the TT began being considered a serious off-road mount and not just a playbike, technology from the competition series was incorporated. Fittingly, therefore, the TT600N was more closely related to the IT and YZ models than ever before. By 1985, Yamaha, the most prolific manufacturer of dirtbikes in motorcycling history, had pulled the different series together as a clearly related family. And just as a thread could be traced between each of the bikes in the 1985 Yamaha off-road line-up, so that thread could be traced back 20 years to those prototypes being tested in the southern Californian desert. The DT1, the harbinger of the off-road revolution, was long gone but its spirit lived on.

Appendix

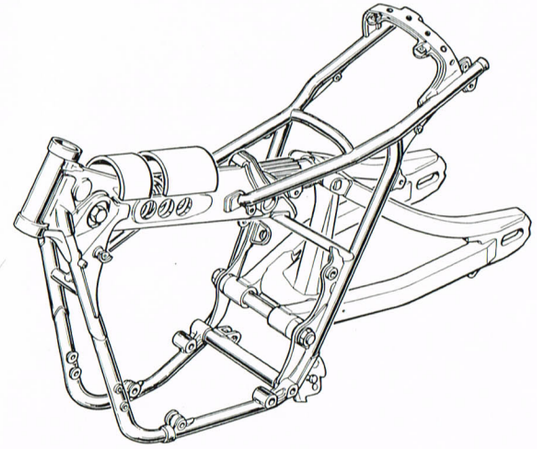
Evolution of monoshock suspension



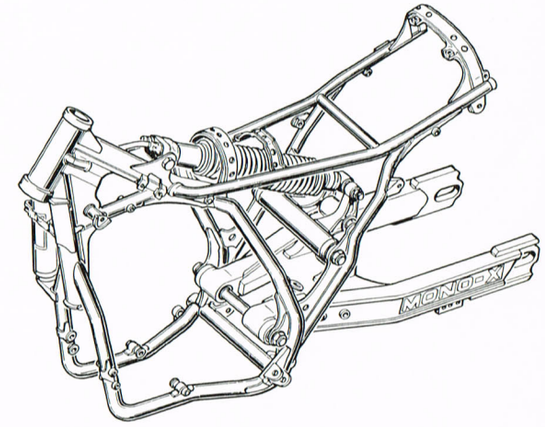
(1) YZ125C



(3) YZ250H



(2) YZ250F



(4) YZ250J