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## TEARDOWN!
## Yamaha RZ500 stripped for inspection

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Cycle Canada brings out the wrenches for an exclusive teardown of Yamaha's water-cooled two-stroke V4 works-replica.





PHOTO BY SCOTT EWEN

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PREVIEW

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YAMAHA RZ500

YAMAHA



PHOTO BY SCOTT EWEN

# YAMAHA RZ500

We couldn't wait.
The latest word from Yamaha is that the stunning RZ500 grand prix replica for the street won't be available until June, and the factory is now touting the bike as an '85 model.

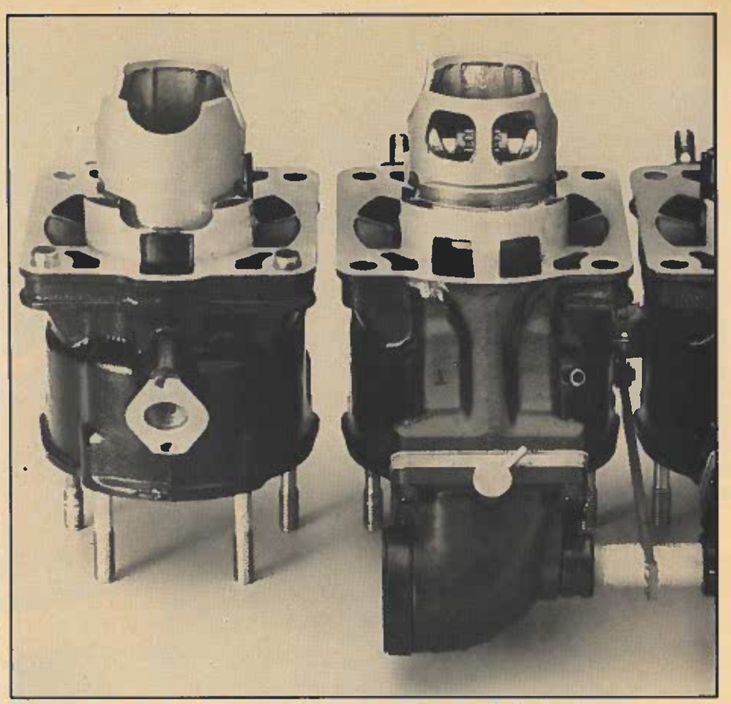
Since the prospect of waiting six months for a test machine was simply too much to take, we approached Yamaha Motor Canada Ltd. and asked to borrow an early prototype for the purposes of a teardown and technical analysis. We also wanted to try sitting on it.

The bike you see here is one of the first three prototypes constructed by the factory, and some details of the production version are bound to change. But we guarantee one thing won't change: when the RZ500 finally arrives in Canada it'll still be one of the most uncompromising sporting motorcycles you can hang a licence plate on.

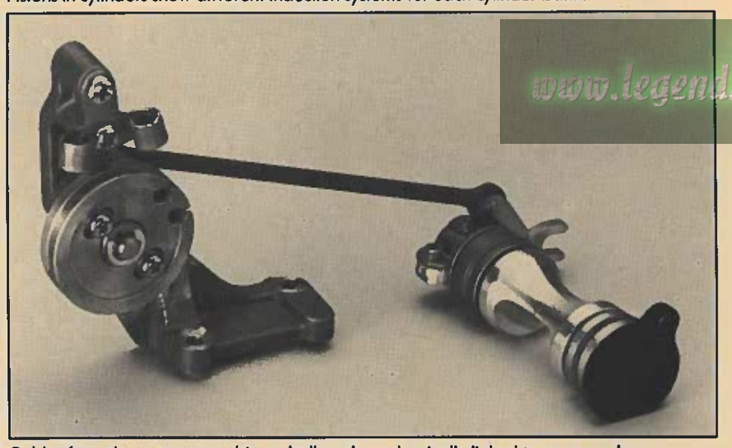
The RZ500 and Yamaha's OW70 500 cc GP racer share the same engine layout. Both are water-cooled, two-stroke V4s with a 50-degree angle between the banks of cylinders. The V4 is essentially constructed of two twin-cylinder blocks with two crankshafts driving a common primary gear. Yamaha chose this arrangement to keep engine width to a minimum. A two-stroke engine requires separate crankcases for each cylinder. One crankshaft would make a V4 almost as wide as an inline four, so Yamaha gave each cylinder bank its own crankshaft. The bore and stroke of the RZ500 are 56 x 50 mm, resulting in a displacement of 492 cc. The dimensions of the OW70 are 56 x 50.6 to bring the displacement as close to the 500 cc limit as possible. The short stroke permits the 10,000 rpm redline without excessive piston speed. Compression is a relatively mild 6.4:1.

Both of the RZ's crankshafts rotate in the same direction. The motor has a 180-degree firing order with diagonally opposed cylinders firing together. Specifically, the lower left and upper right cylinders fire together, as do the lower right and upper left. Unlike the race engine, the RZ500 uses a two-weight balancing shaft geared to the front crankshaft. The balancer is located between the cranks for compactness and is designed to reduce vibration arising from the primary rocking couple.

Perhaps the greatest departures from the OW70's engine design are the cylinders and their intake porting arrangements. The race bike uses rotary-valve induction, while the RZ500 has two different intake systems for the separate sets of cylinders. The front cylinders feed through reed valves directly into the crankcase, while the rear cylinders are of the reed-valve piston-port type. The front cylinders have five transfer ports while the rear set uses four transfers and a boost port. As a result, cylinders and pistons are not interchangeable between upper and lower pairs. The transfer ports appear to be of similar size and timing for all cylinders. The transfer ports on our prototype were never fully uncovered, even with the piston at top dead centre, leading us to believe that there might be more horsepower to be found by simply installing more than one base gasket.



Pistons in cylinders show different induction systems for each cylinder bank.

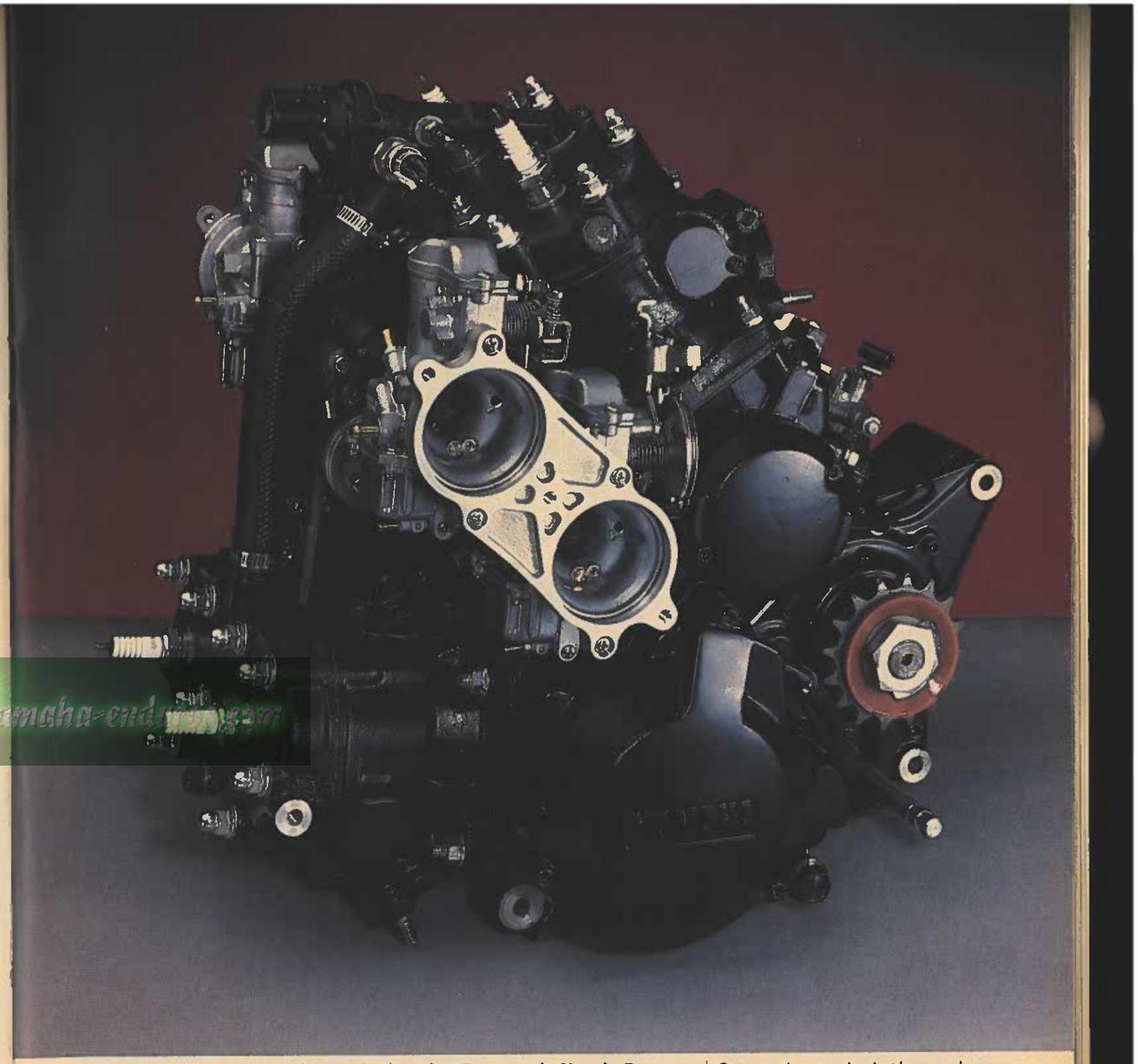


Cables from the servomotor drive a bellcrank mechanically linked to power valve.

There certainly won't be any easy power gains through the modification of the intake system. The decision to use two different types of induction must have required Yamaha engineers to spend many hours of development matching the volumetric efficiency of both sets of cylinders. Back-yard modifications of the intake tract with a Dremel grinder are not recommended, since it would be very easy to get the separate cylinder sets producing different power levels and have one set resist the other. Anyone tuning the RZ500 will have to be very careful.







The limited space between the cylinder banks doesn't allow the normal positioning of the carburetors. Instead of facing directly into the ports, they are twisted 90 degrees from the normal position, so the intake boots bend sharply before reaching the cylinder. The carburetors are mounted two to a side, in a split-level arrangement. The lower pair feeds the front cylinders and the upper two are for the rear bank. Each set of 26 mm Mikuni carburetors has a balance tube connecting the carb throats. The airbox is located behind the steering head and the filter is oiled foam.

The RZ500 uses the Yamaha Power Valve System (YPVS), consisting of a cutaway spool valve that rotates to change the exhaust-port height in response to engine rpm. A microprocessor-controlled servomotor rotates the valves by a combination of cables and mechanical links. The YPVS reduces the exhaust-port height, and thus port timing, at low rpm. At high rpm, the power valve is fully open, advancing exhaust-port timing, and allowing the engine to develop peak power.

The power valve is similar to the RZ350's, but its drive arrangement is different. The RZ350 uses two cables driven by the servomotor to rotate the two linked valves. The RZ500 has two separate pairs of valves and so the cables from the servomotor drive a bellcrank which is mechanically linked to each valve assembly. This allows adjustment of the cables to determine the rpm at which the valves begin to open and a separate adjustment of the bellcrank to synchronize the two assemblies.

One question remains: just how much horsepower does this engine pump out? Tuning will need to be mild for street.

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The RZ500 engine incorporates two oil pumps. The Autolube pump, located behind the upper cylinders, feeds two-stroke lube to each of the four reed cages. A cable connects the servomotor to the pump. Since the operation of the servomotor is rpm dependent, regardless of throttle position, this cable keeps the oil pump working at its maximum capacity when the throttle is closed at high rpm, while braking for a corner. The second, trochoid pump, is positioned low in the transmission. This pump pressure-feeds the output shaft and also the split primary drive pinions, because both crankshafts and the output shaft are above the gearbox oil level and consequently aren't splash lubricated.

The transmission has six speeds and uses a wet clutch, instead of the racer's dry clutch. The clutch basket, transmission gears and shafts are quite large, and are about the size usually found on 1,000 cc bikes.

The front expansion chambers run under the engine and exit near the rear wheel, while those from the upper cylinders exit directly from the rear and cross beneath the seat before poking out of the tail cowling.

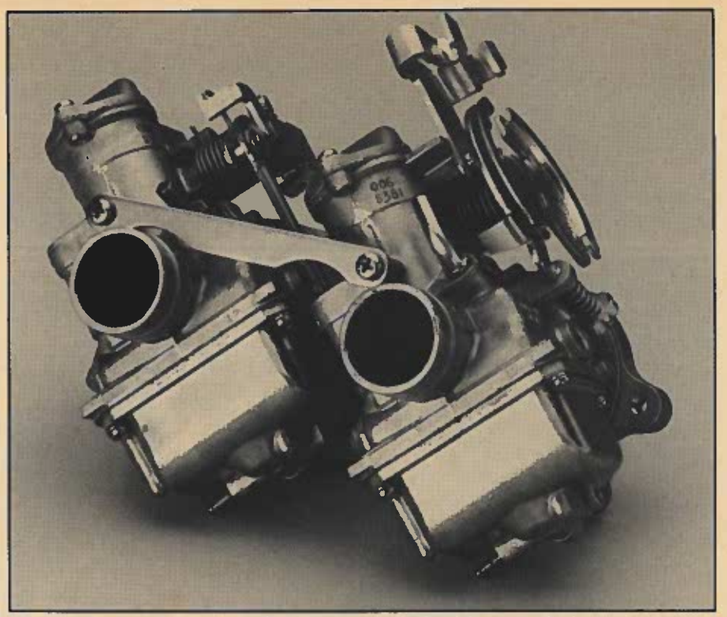
The CD ignition has one pickup and two triggers. This results in all four spark plugs firing at the same time, even though two pistons will be at bottom dead centre. The ignition system retards the timing at high rpm to prevent overrevving.

The radiator mounts on the front down tubes and a thermostat controls an electric fan to ensure a constant operating temperature.

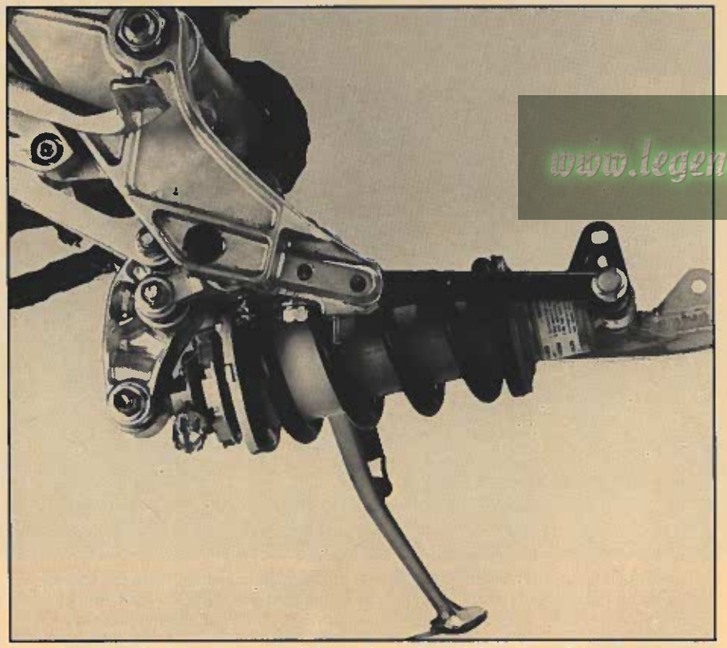
The RZ500's chassis is as innovative as its engine. From the GP-style fairing to its aluminum rectangular-section frame, this bike screams racer, although the word from Yamaha is that production versions will have steel frames. The frame incorporates much of the latest designs from Yamaha's grand prix racers. The large section main tubes are widely spaced and sweep back from the steering head at an angle, meeting the lower engine cradle at the casting which holds the swingarm. The steering head is well braced and the swingarm pivot area is braced by two sturdy transverse frame members. The engine is mounted solidly to the frame at four points: two at the rear of the motor and two others at the bottom of the front cylinder bank. The lower right frame cradle is detachable for easier engine removal. The swingarm is a box-section aluminum extrusion of very large proportions, with enough clearance to accept up to 150/80 width tires.

The single shock used in the Monocross rear suspension mounts beneath the motor, and is retained by a bracket that has long extensions along the shock anchored to a transverse frame member. This bracket is also attached to the motor to position the shock laterally. The forged aluminum-alloy linkage arms provide a rising suspension rate and all the pivots have grease nipples for ease of maintenance. The DeCarbon-type shock is adjustable for spring preload and rebound damping. The damping adjustment has five positions, set with a knob that faces downward from the shock body.

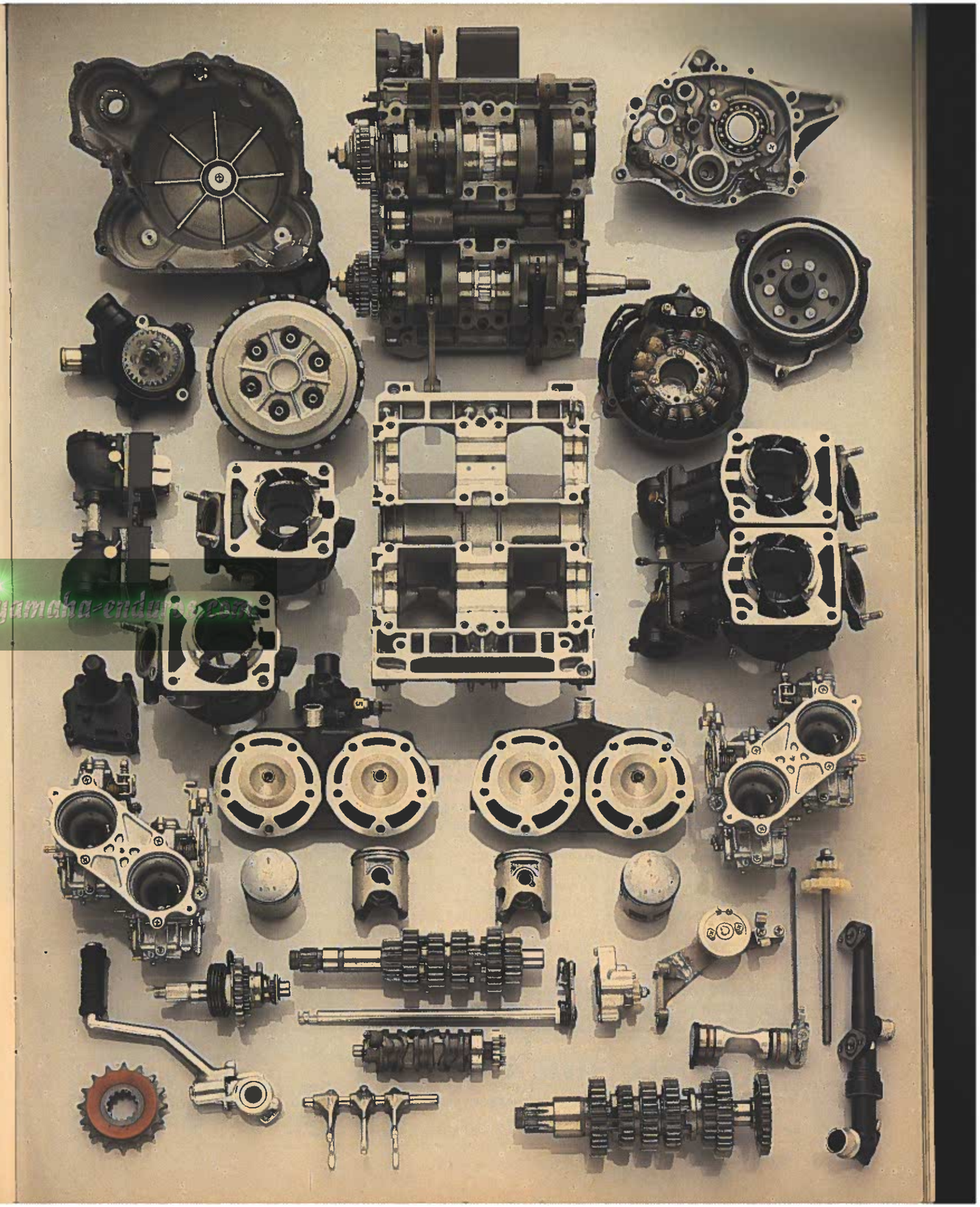
The front suspension of this prototype had no provision for air or damping adjustment, but did include a hydraulic anti-dive system. Yamaha has taken great pains to reduce unsprung weight to

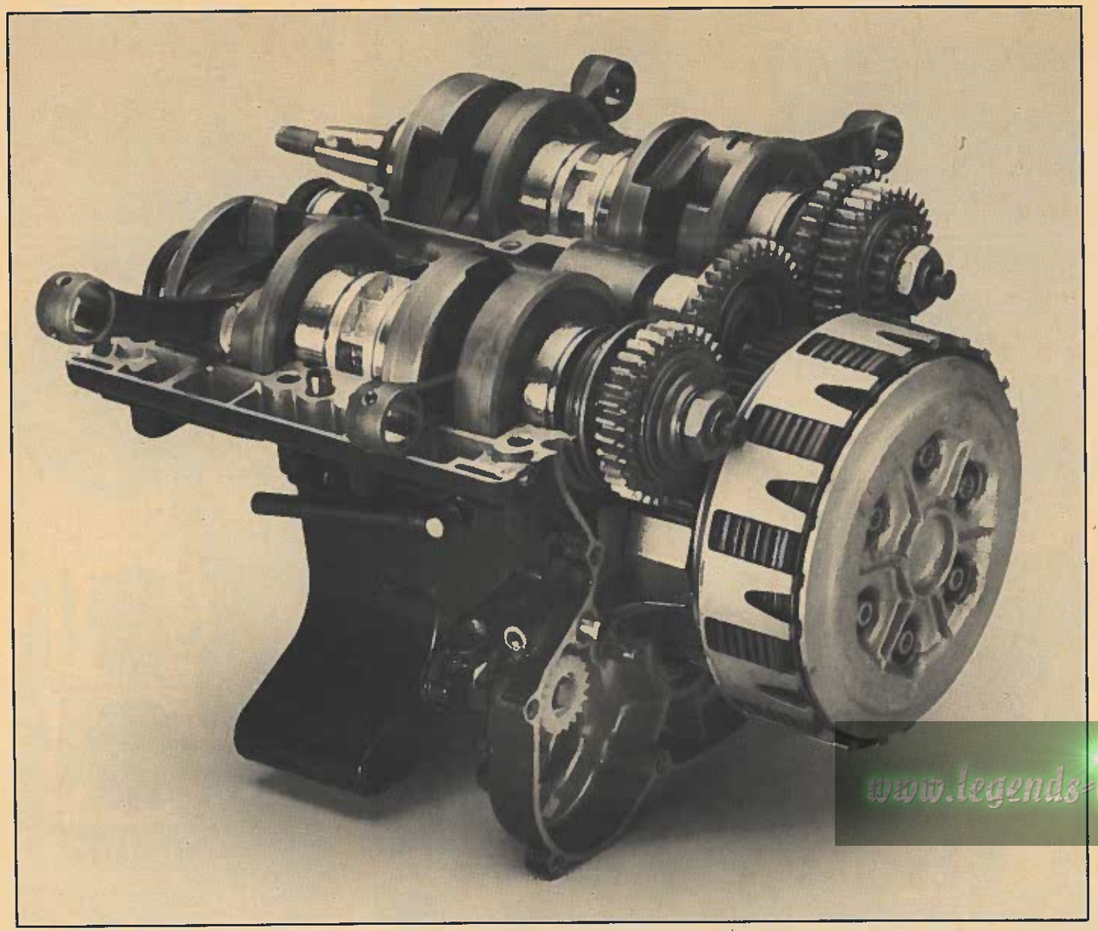


Mikuni carbs are set in staggered pairs; upper carbs feed the rear cylinders.



DeCarbon-type shock has Monocross linkage, five rebound damping adjustments.





Separate cranks drive a common primary gear. Balancer shaft between the cranks compensates for primary rocking couple.

# YAMAHA RZ500

a minimum. Reducing the ratio of unsprung weight to sprung weight improves both ride quality and handling. This has been accomplished by removing unnecessary metal from the wheels wherever possible, to the point where most of the front axle is exposed. The bearing supports connect to the hub via short, thick spokes. The ventilated disc brakes further reduce unsprung weight. They are no thicker than normal discs, despite the internal ducting.

The RZ500's fork tubes are 36 mm in diameter and incorporate two fork braces, one curving under the fender and another mounting flat across it.

At 1,375 mm, the wheelbase is 10 mm shorter than the RZ350's. The steep rake in conjunction with the 16-inch front wheel should yield very quick steering. It's interesting that Kenny Roberts's OW70 race bike ran most of the '83 season on an 18-inch front wheel, although smaller front wheels were tested.

Yamaha has taken the trouble to mount the instruments to the frame-mounted fairing, reducing the front fork assembly's moment of inertia and enhancing both steering response and high-speed stability.

Dry weight is 181 kg (400 lb), but the bike feels more compact to sit on than the lighter RZ350.

The wheel rims are very wide at 2.75 x 18 front and 3.00 x 18 rear. Tires are V-rated Michelin A48 120/80-16 front and M48 130/80-18 rear.

The RZ500's ventilated disc brakes should resist disc distortion and brake fade from heavy use. The twin front discs and single rear disc have opposed-piston calipers and should provide extraordinary stopping power.

Yamaha's RZ500 fairing resembles that of a grand prix racer more than any other fairing offered on a production bike. It mounts very low on the frame and appears to be streamlined enough to reduce aerodynamic drag. It's constructed in four pieces, allowing easy engine access.

The RZ500's chassis design is a definite step forward and shows Yamaha has decided that maintaining fork rigidity and minimizing the front fork's inertia and unsprung weight are as important to good handling as adjustable suspensions and 16-inch front wheels. The engineering refinement isn't limited to features such as a rectangular-section frame with cosmetic appeal. The RZ500's racing heritage is genuine.

Yamaha has taken a brave step by introducing such an uncompromised high-performance motorcycle. The RZ500 will certainly not be an all-round performer for the masses, but for the rider who wants and can afford one, there is no substitute.

Perhaps, the best way to sum up the appeal of the RZ500 is with the query of a passerby who spotted us loading the bike in our van: "Is that a GP racer?"

No, it isn't, but the Yamaha RZ500 is the closest thing to it. We can't wait to ride one. □

PHOTOGRAPHY BY SCOTT EWEN