

cycle

JUNE 1976 75 CENTS



**EXCLUSIVE:
YAMAHA'S NEW
SHAFT-DRIVE
XS750D TRIPLE**

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• Deep inside its several basic-black cases and compartments the new Yamaha XS750D is a technoid's delight, especially with respect to its absolutely labyrinthine power train and clever self-cancelling turn indicators. We'll get to the mechanical minutiae in due course, but for most of you none of it is as important as simply knowing that Yamaha's 750 triple genuinely is an all-new design and not an XS500 twin with an extra cylinder and shaft drive, as some people have supposed; that Yamaha has, with the triple, made a quantum leap ahead of other

Japanese big bikes in the area of ride quality; that the XS750 is an exceptionally nice motorcycle by any standard and at any price; and that its solid virtues and worthwhile features do more to justify the triple's price than anyone would expect in today's inflated marketplace. Yamaha's last 750, the ill-fated tapioca TX750, was an internal-combustion Custer's Last Stand; the XS750 is everything the old twin was not, is many things the XS500 only tries to be, and it's a winner to the core.

Nobody will have to ride an XS750 more

than half a day to discover the most outstanding of its many virtues, and the experienced rider will find himself in for some real surprises. A big one will be the XS750's smoothness, which is not what we expect in large-displacement triples. The late Triumph Trident's engine was a 750cc triple, and a chassis-aggitator to the end. Kawasaki's H2 two-stroker also has three crankpins spaced at 120-degree intervals and will give you a vibro-massage you'll not soon forget. And the Laverda 1000, with one-up, two-down crankpins, can be considered smooth only



relative to bikes like the Triumph and Kawasaki. So the Yamaha triple really should shake, but doesn't—at least not at any substantial level even in its worst moments, and it's GL1000-smooth at certain engine speeds. Most significantly, the new Yamaha is smoother than either the Honda 750-4 or the Kawasaki 903 at normal highway cruising speeds.

Another big surprise, to us, was the Yamaha's ride. Like all those who've been in motorcycling for more than a couple of years we had come to assume that BMW

had a hammerlock on suspension technology and that Japan's motorcycles—what-ever else might be said for them—would forever ride as though they had solid brass spacers instead of springs. Let the record show that Yamaha swept away that quaint notion, because—give or take the smallest of margins—the new XS750 fits squarely within the same ride-quality brackets as the latest BMWs, which previously were in a class by themselves, and comfortably ahead of anything else (except the RD-400C) you can buy for less than \$3000. Run the Yamaha over

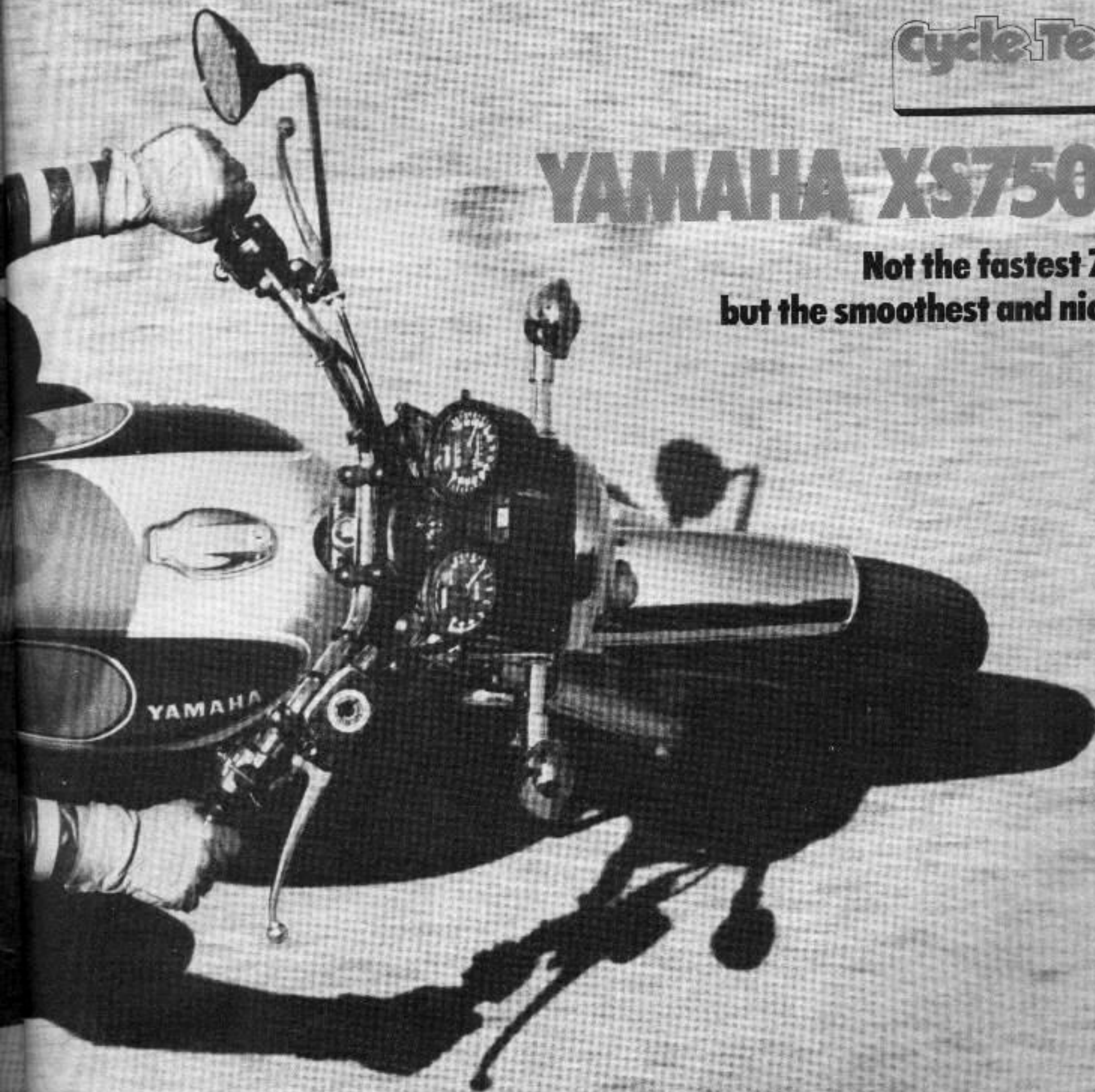
washboard ripples, potholes or even those jolting, sharply-raised expansion strips and you get a wonderfully supple response from the bike's suspension.

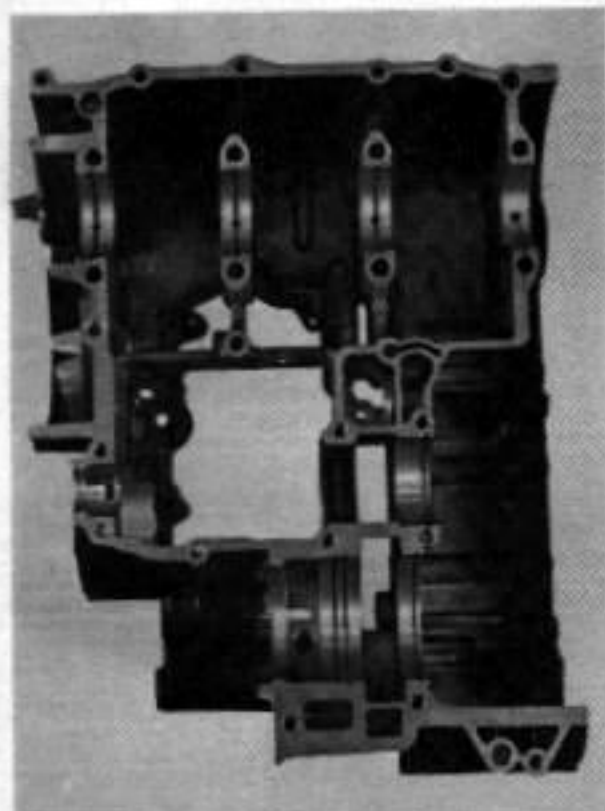
For what it's worth, the Yamaha triple has a very mellow sound. The bike's three double-wall exhaust pipes feed into a muffler that's more than 30 inches in length, 4½ inches in diameter and baffled like a Minotaur's maze, so not much sound emerges from its outlet. But the subdued beat that does escape the muffler's interior mixes with the throaty basso from the air

Cycle-Test

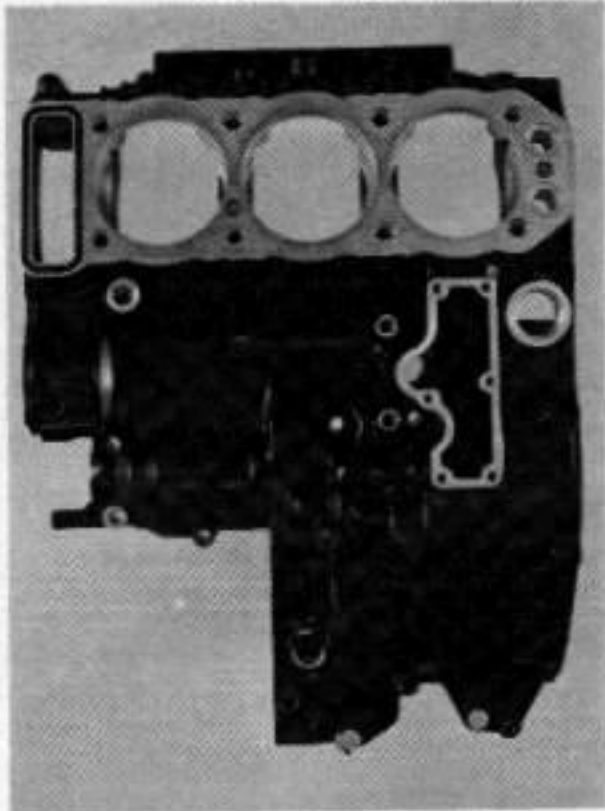
YAMAHA XS750D

**Not the fastest 750,
but the smoothest and nicest.**

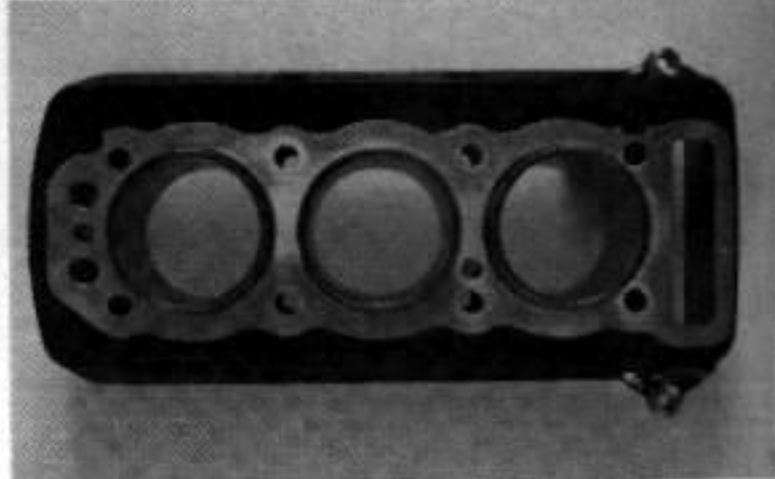




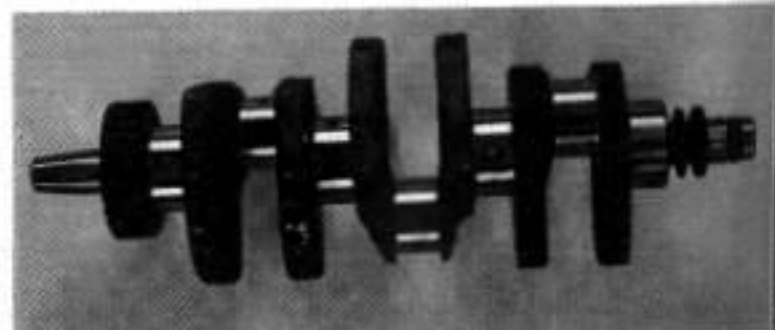
This intricate casting holds half the supports for the crank, transmission and transfer-gear shafts.



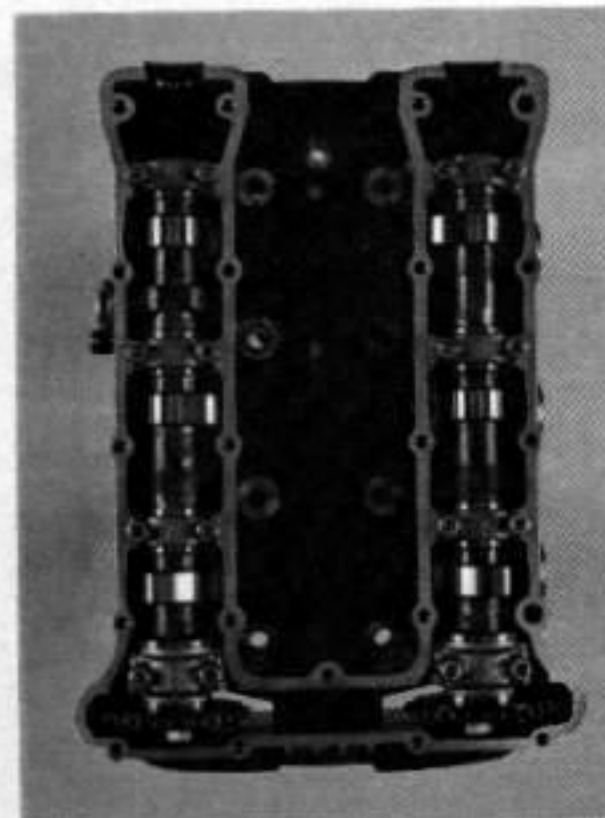
The cavity behind the cylinder block surface in the upper crankcase half is for an elaborate breather.



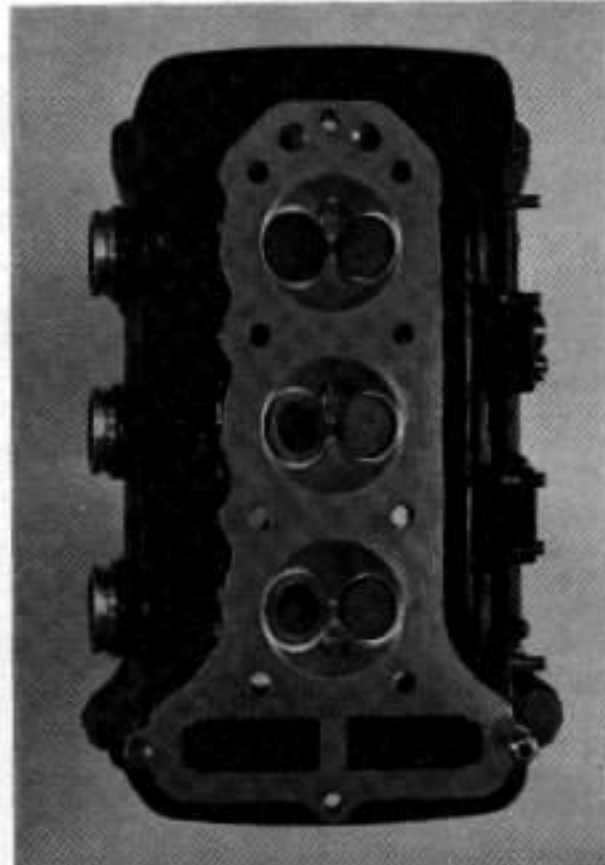
Three iron sleeves in a one-piece block, flanked by a timing chain chest and drilled oil passages.



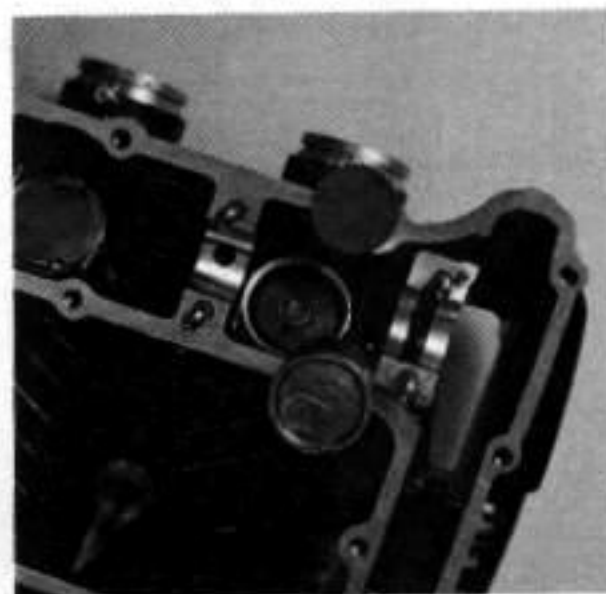
The crankshaft is a steel forging, with four mains and crankpins evenly positioned 120-degrees apart.



Valve clearance adjustments are made by selecting from a variety of cam follower face-disc "shims."



Hemispherical combustion chambers, with single 36mm valves on the intake side and 31mm exhaust valves.



Chain-driven camshafts operate the valves through a set of Z-1/Otchy-style inverted-bucket followers.



The three 34mm constant-vacuum Mikuni carburetors are idle-adjusted by turning a single knurled knob.

intake for a nice effect. At low speeds, under light throttle, you hear the whine of gears and the clicking of cam followers fairly clearly; these rather harsh mechanical noises go away once the butterflies rotate open and the revs begin to build.

Yamaha claims a 4.5-gallon fuel capacity for the XS750, and you probably could get that much gasoline out of the tank by wringing it like a washcloth. Be that as it may, the capacity that counts on a day-in, day-out basis is the number of miles you can ride before switching a bike to reserve, and the Yamaha triple does provide quite a useful main-supply cruising range. One of our test riders managed to make the XS750 squander fuel at the rate of 36 mpg, but 40 mpg is a much more representative mileage figure for moderately hard riding. Surprisingly, the triple's fuel consumption rate varied only slightly whether it was being used for free-

way travel, plodding through clots of city traffic or charging mountain roads. Under most conditions it delivered a constant 40 mpg, and could be relied upon to gasp out a fuel-starvation signal just as the last of the fourth main-supply gallon dribbled down to the carburetors and the resettable trip-meter flashed 160 miles. At that point we'd flip the fuel petcocks to their reserve position and start looking for a service station, though there was—in theory—a half gallon of gasoline and 20 miles of motion left in the Yamaha.

Filling the XS750's fuel tank is the only service it requires at less than 1000-mile intervals. The owner's manual says that's how often the air filter should be cleaned, and the battery, brake fluid and tire pressure checked. You're supposed to clean the spark plugs and check the ignition timing at 2000-mile intervals, and the manual also

YAMAHA XS750D



suggests cleaning the fuel petcocks' strainers and the traps at that point—perhaps because the engine will run happily on the cheapest kind of gasoline and they figure some XS750 owners will be steady patrons of the worst cut rate Petro-Swill service stations in the country. Cam chain adjustments are scheduled 3000 miles apart, as are straightforward replacements of engine oil and the oil filter; draining and refilling the drive system's cavities is expected at 6000 miles. For this last job, the bike's tool kit contains a double-end dip stick, which is stabbed down into the appropriate filler holes to gauge the level of the gear oil.

One item unaccountably missing from our test bike's tool kit was a spanner for cranking the rear suspension's lower spring collars up and down. These collars have the usual notched spiral ramps for spring preload adjustments, and a five-notch load

range, but that doesn't help much unless you have the proper tool. Still, with that single exception the kit was fairly complete—and a very close fit inside its underseat compartment. You won't just dump the wrenches, screwdriver and pliers back in the bag and drop the whole thing into the little storage tray; some of the wrenches have to be nested inside the kit's tubular sockets and the rest carefully compacted before the flap can be snapped closed and the bag stowed tidily enough so the seat will drop down and latch.

When we were fishing around in the kit looking for the proper spring adjusting tool we'd have settled for an improper tool, because the collars were full down and so was the Yamaha's cornering attitude. You really are going to like what Yamaha has done for the XS750's ride; yield to your sporting instincts and you may wonder if the admittedly

superb ride has not been purchased at too great a price. The bike's very soft springs (28/33.5 pound-inch and 106/145 lb-in progressives front and rear, respectively) and considerable all-up weight (717 lbs.) cause the chassis to sink on the suspension under cornering loads, and you'll find the Yamaha running out of cornering clearance long before it runs out of tire adhesion in right-hand turns. You can hook the XS750 into left-handers very smartly—we wore the Honda-style "That's Far Enough" feeler nub right off the left footpeg end—but you won't get tilted very far to the right before the exhaust system starts graunching against the pavement.

With some bikes it's just as well there's a built-in exuberance limiter, as they'd go into a mad wobble and pitch you into the nearest hedge if their low-hanging pipes would allow fast cornering. That's not the case with the

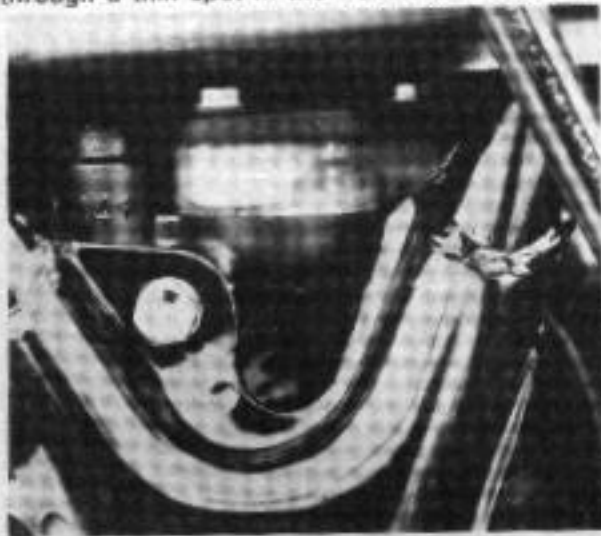
**Comfortable seating
and a superb ride.**



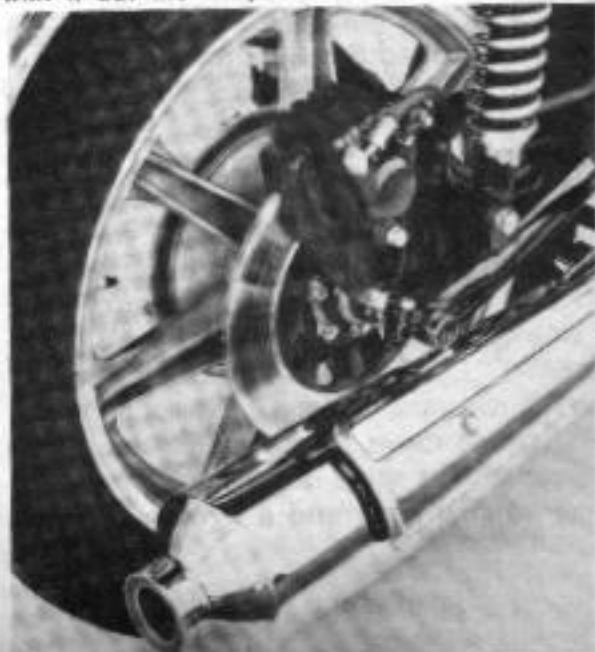
YAMAHA XS750D

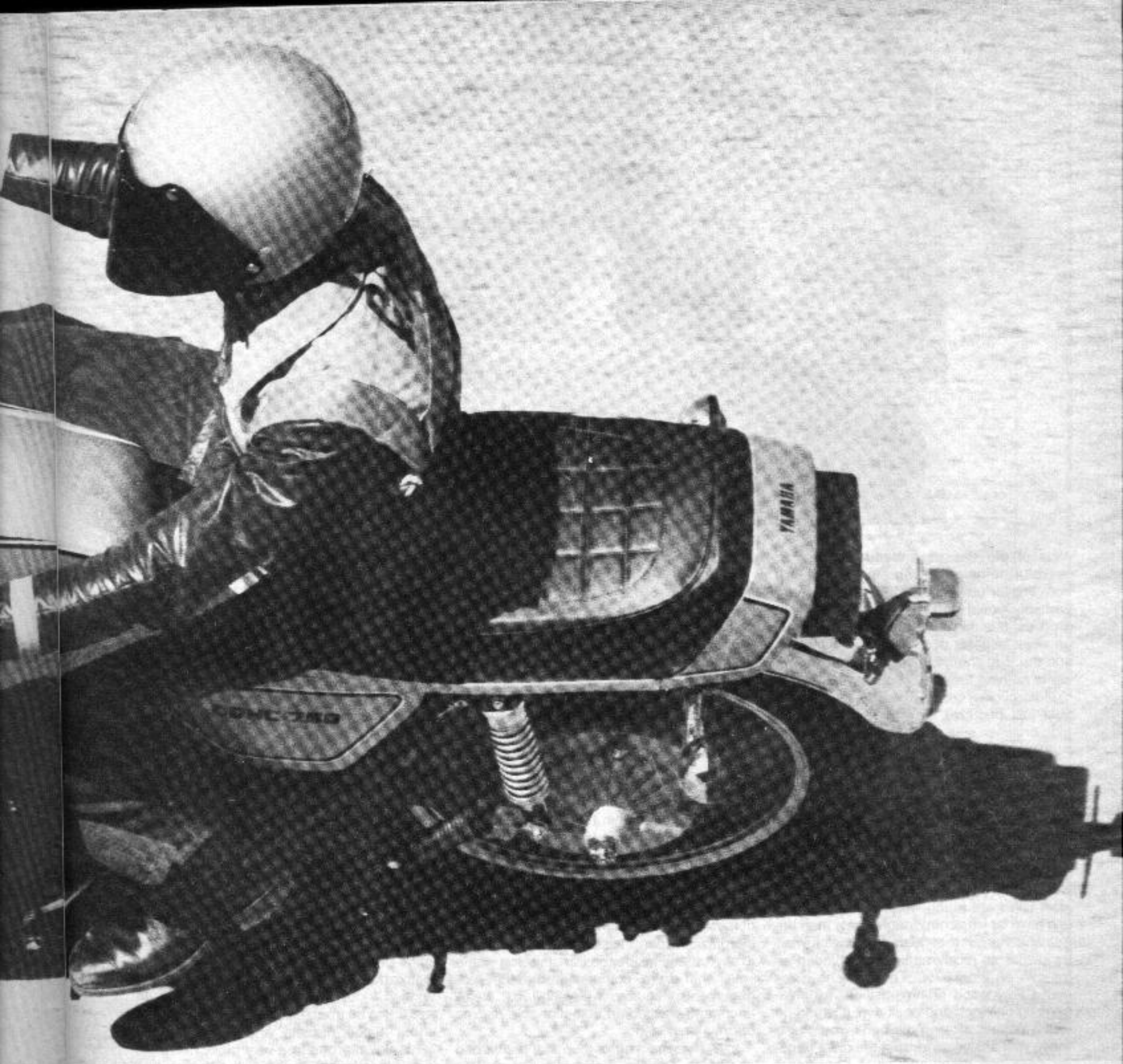
Yamaha XS750: the bike rocks and surges on its soft suspension when it's ridden immoderately, and that does take a little of the precision out of its steering, but it never does anything bad. And the steering geometry has been very carefully arranged for the full spectrum of riding conditions, as the bike's handling is comfortably light when you're maneuvering around at a walk, and it's not too light at high speeds. We found only two things the XS750's handling couldn't handle: the bike does lurch smartly when its exhaust system bangs down hard, and the ribbed-tread front tire tends to get the steer-

The rear-brake master cylinder's fluid level shows through a thin spot in the translucent reservoir.

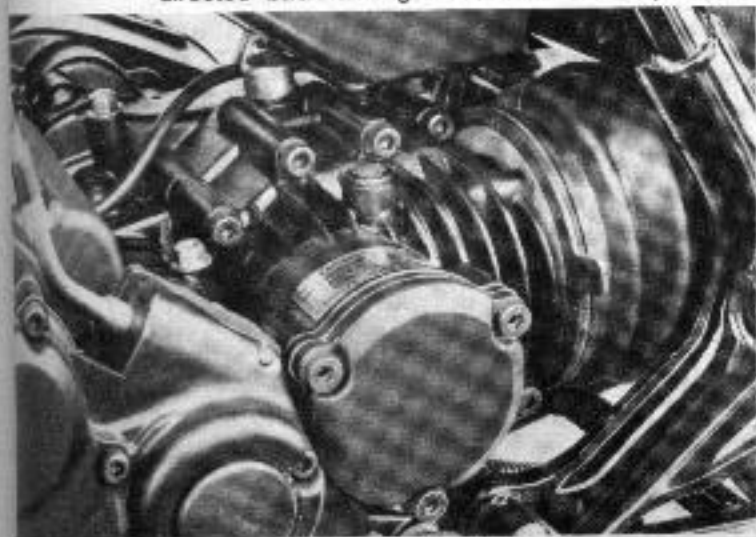


When the rear wheel is removed the brake disc goes with it but the caliper remains on its bracket.

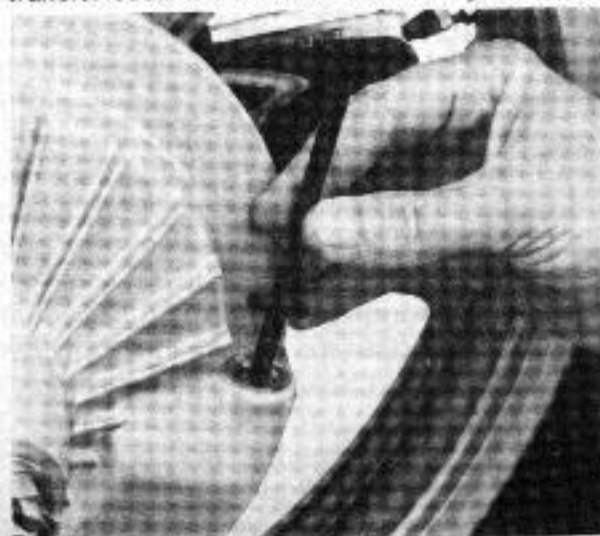




Here's where the drive is turned 90-degrees, and is directed back through a constant-velocity U-joint.



A double-end dipstick is used to check the forward transfer-case and final-drive housing oil levels.



ing twitchy when it tries to cope with freeway rain grooves.

Owners will find that the XS750's cornering clearance can be increased by adjusting its suspension. Cranking the rear spring preload adjusters around to their highest notches will lift the bike's tail about 14mm (.55-inch), and there is a similar upward adjustment available in the front fork. The fork tubes' reach was established in prototype testing, and a bit of length added in the production version—which extends up through the top fork bridge, as is done in Yamaha's off-road machines. You can use the extra length to fine-tune the bike's steering geometry, but we think the best results will be obtained by going for a lift at both



ends of the chassis and an increase in overall ride-height. Switching the ribbed front tire for one with a block-pattern tread probably would stop the twitching over rain grooves; this might have some bad effects on other aspects of the XS750's handling, and the side-shuffle, though disquieting really is nothing to worry about.

Motorcycles aren't necessarily comfortable just because they ride well; a hard, high-crowned seat or poorly arranged riding position can be instruments of torture. Here, the Yamaha is a mixed bag: the seat is as broad and soft as anything you could want, and if you're tall enough it's near-perfect; the short rider will find that the seat's just a tad too wide at its forward end, and creates a pressure point at the inside of each thigh. And the footpegs are slightly too low and set too far forward. We should point out that most bikes are much worse in this regard, and have far less comfortable seats than the Yamaha. Rarely, too, do motorcycles have a handlebar as nicely angled and placed as the one on the XS750. The Yamaha gives you a very good riding position; with the pegs up one inch and back two, it would be nearly perfect. Moving the pegs would also move your ankles away from the drive transfer case and swing-arm pivot housings—which became (literally) sore points for one of our test riders.

All of us became accustomed to the triple's abrupt off-idle throttle response and drive train lash; we never learned to like it. The constant-vacuum Mikuni carburetor has the advantage of compensating for ham-fisted riding techniques, as the slide automatically adjusts its position over the fuel nozzle to keep the air speed high even when the butterfly is suddenly snapped open. This automatic compensating feature gives exceptionally good mid-range throttle response. But it also combines with the butterfly-type throttle valving to make for a too-rapid transition from idle to serious power; it's just as though the first degree of twist-grip rotation flips the throttles from

closed to an eighth-open.

As noted, the XS750 is afflicted with that most familiar of ailments—drive train lash. There is, by careful measurement, a loose 18-degrees of free motion in the bike's rear wheel with the transmission in first gear, which probably is less than the average for Japan's touring bikes, but still too much. A contact at Yamaha said the between-faces clearances at the shifting dog teeth (where the lash originates) could not be closed any farther without introducing an engagement problem. If we may be presumptuous and offer advice, we would guess that they've made the shifting-cam drum diameter too small, which results in the shifter-fork camming slots being too steep—and this is reflected in a somewhat notchy feel at the shift lever, an insufficiently positive force to drive the shift dogs into engagement, and a tendency for the dogs to bounce apart instead of meshing unless there is a very considerable gap between their teeth. They've opted to save space inside the transmission with a small shift drum, compensated for the engagement difficulties with dog-teeth clearance, and created an objectionable degree of drive-train lash.

In every aspect other than that mentioned above the Yamaha triple's power train is a marvel, and one that appears to have been arranged with a sharp eye for results and a blind one for cost. Some form of chain-and-sprocket primary drive had to be used to carry power from the crank to the clutch, as even the slight clearance between the crankshaft's main journals and their supporting plain bearings would upset the meshing of gear teeth. Yamaha wisely chose a Hy-Vo chain, which has proven to be both silent and absolutely reliable in such applications. Moreover, rather than accept an overhung load on the clutch, they provided an extra support bearing on that assembly's outboard side.

The XS750's clutch hub contains the first of its two drive-shock cushions. In this one, the drive goes through a collar with three V-

shaped cam slots and three cylindrical pins before passing into the gearbox. Belleville spring washers force the pins down into the points of the V-slots; drive shocks move the pins up the sides of the slots and are softened by the resulting compression of the spring washers. There is a second, simpler, shock cushion (a pair of two-lobe cam rings held together with a coil spring) in the cross-shaft that connects the gearbox output shaft with the right-angle gears that turn the drive 90 degrees for its trip back to the rear wheel. The spur gears that transfer the drive out of the gearbox to the cross-shaft, presently having 34 and 32 teeth, respectively, can easily be changed to get a different overall drive ratio. Alternative gear sets are not presently available, but—according to our sources at Yamaha—are scheduled for the not-too-distant future.

Right where most motorcycles have a transmission output sprocket, the XS750 has a bolt-on casing containing a pair of spiral-bevel gears. The drive gear has 19 teeth and the driven gear 18 teeth, because hunting tooth gear sets are less noisy and less apt to be troublesome than pairs with an equal number of teeth. And the driven gear feeds drive torque to a very tricky universal joint placed right at the swing-arm's pivot line. Conventional U-joints won't transmit rotation at an angle without setting up cyclical speed variations, which are reflected as torque pulsations in the drive system. Yamaha, unlike BMW or Honda, bit the financial bullet in this matter and went to an expensive constant-velocity U-joint—one in which the drive passes across six large ball bearings carried in grooved inner and outer spherical members. This kind of U-joint will operate at large angles without any change in input/output speeds and without creating any drive pulsations, which is why it is widely used in front-wheel-drive automobiles. Ordinary Hooke joints are cheaper; they aren't as good.

The penultimate step in the drive's cir-

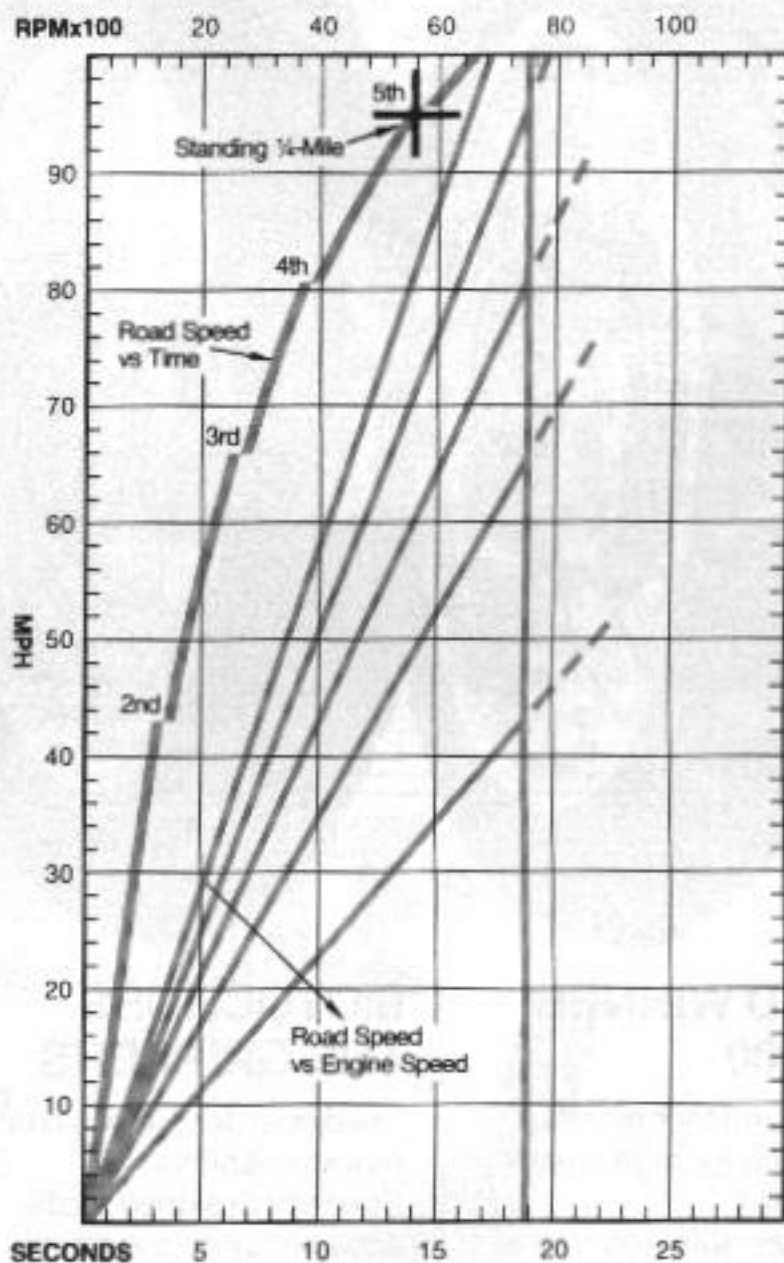
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CYCLE



YAMAHA XS750D

Price, suggested retail	\$2236
Tire, front	3.25H19 Bridgestone
rear	4.00H18 Bridgestone
Brake, front	10.51 x 1.45 in. (267 x 36.9mm) x 4
rear	10.51 x 1.45 in. (267 x 36.9mm) x 4
Brake swept area	252.18 sq.in (1627.06 sq. cm.)
Specific brake loading	2.84 lbs./sq. in. at test weight
Engine type	Four-stroke, DOHC air-cooled triple
Bore and stroke	2.68 x 2.70 in. (68 x 68.6mm)
Piston displacement	45.58 cu. in. (747cc)
Compression ratio	8.5:1
Carburetion	3, 34mm Mikuni BS34
Air filtration	Dry foam
Ignition	Mechanical breakers, triple coils
Bhp @ rpm	n.a.
Torque @ rpm	n.a.
Rake/Trail	27°/4.49 in. (114 mm)
Mph/1000 rpm, top gear	14.54
Fuel capacity	4.5 gal. (17.0 Liters)
Oil capacity	3.7 qt. (3.5 Liters)
Electrical power	Alternator, 14.5V-18Amp @ 5000 rpm
Battery	12V, 14AH
Primary transmission	HY-Vo chain
Secondary transmission	shaft, spiral-bevel gears
Gear ratios, overall	(1) 13.39 (2) 8.64 (3) 7.07 (4) 5.96 (5) 5.20
Wheelbase	57.7 in. (1465 mm)
Seat height	31.9 in. (810mm)
Ground clearance	5.7 in. (145mm)
Curb weight	552 lbs. (251 kg)
Test weight	717 lbs. (326 kg)
Instruments	Tachometer, speedometer w/odometer and tripmeter, oil, neutral, high-beam, turn-signal indicators
Standing start 1/4 mile	13.98 sec.; 95.33 mph
Average fuel consumption	40 mpg
Speedometer error	30 mph, actual 27.33 60 mph, actual 55.69



cuitous trip from the crankshaft to the rear wheel is along a drive shaft inside the left swing-arm tube. This drive shaft is only 17mm (0.67-inch) in diameter, and doubles as a torsion bar drive cushion. The shaft's small end is splined into the permanently-lubricated, sealed U-joint; its aft end is flared, with spherical-segment splines, and slips inside a splined collar on the final-drive pinion shaft. The last link in the drive train is an automotive-looking ring and pinion assembly in a light-alloy housing (32 teeth on the ring gear, 11 on the pinion) and is unusual only for having a straddle-mounted pinion gear. That is to say, in addition to the usual tapered-roller support bearing behind the pinion gear, there is a needle-roller bearing holding a small-diameter extension on the pinion gear's nose.

In all likelihood XS750 owners will not have occasion to see much of the bike's elaborate drive train scattered around a service-department workbench. Similar systems in automobiles outlast all other components. The important thing for owners to know is that Yamaha has made removing the rear wheel for flat-fixing a fairly straightforward, easy task. Remove two bolts and you can swivel the rear fender extension up out of the way; two more and you have the muffler heat shield off, which clears the way for pulling the axle. The axle is held by a large nut at the drive-casing end and by a small pinch bolt on the right side, and when you pull it out of the wheel hub a spacer will drop out—creating enough side clearance to let the hub move off its drive splines and

then straight back away from the swing arm. The rear brake disc stays bolted to the wheel; the brake caliper is left in place on its bracket.

XS750 owners obviously will not have to give any time to wheel maintenance, beyond an occasional cleaning, because the wheels are very sturdy one-piece aluminum castings. No spokes to tighten; no wobble develops in the rims. The front wheel is a 19-incher with a 1.85-inch rim width; the rear is a 2.15 x 18, and neither is intended to be fitted with tubeless tires.

We've said, on many occasions, how well we liked Yamaha's fixed, twin-piston brake calipers, and used them as an example pointing to the fundamental advantages of that layout. But the new triple has single-piston calipers on floating mounts, and these work extremely well. If you've had experience with other dual-disc, floating caliper front brakes you'd expect that the XS750's would be powerful but with a spongy feel. In fact, the triple's front brake is powerful—and it's both solid and entirely predictable. You couldn't want anything much better. And the rear disc also works well, with a good ratio of pedal-pressure to braking action and no surprises.

Another point we've made much of is that front brake calipers should be mounted behind fork legs, which brings their mass close to the steering axis and reduces the pendulum effect of the fork assembly. The Yamaha XS750 has rear-mounted calipers, and we'd like to think it gains a little steering precision thereby, but that's not the most

remarkable aspect of the fork layout. What we found really amazing was that Yamaha had found a way to virtually banish static friction from the fork sliders, and this accounts—in large measure—for the triple's ultra-smooth ride. Yamaha's answer to the persistent fork "stiction" problem was to provide a slippery plastic lining around the top of the fork slider, where the load is high and the lubrication scanty. The low-friction lining alone isn't the whole story: they also installed very soft, two-rate springs, with lots of preload. So you don't get a lot of friction feeding road shocks up into the handlebar, and the first couple of inches of fork travel—which will absorb 99 percent of the bumps in most roads—is supported by a pair of very soft 28 lb-in springs.

Yamaha's cleverness was not exhausted with the triple's front fork. The bike also has the company's new self-cancelling turn indicator system, which turns off after 10 seconds, or after the bike has traveled 150 meters (164 yards), depending on which occurs last. At freeway speeds you cover 150 meters in a twinkling, so the flashers keep going for 10 seconds; you'll wait more than a minute for some traffic lights, and in that case the indicators will keep on indicating until you've made your turn and gone the 150 meters. It's all handled by a little black box that senses distance by counting the pulses coming from a magnetic reed switch in the speedometer head, and has its own 10-second clock as part of an integrated circuit board. Or, if you'd rather cancel the

(Continued on page 96)

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YAMAHA 750 *Continued from page 51*

signal yourself, punching the turn button in with your thumb does the trick.

The XS750's engine isn't particularly clever, but it strikes us as being completely sound. In this design, Yamaha forgot about multi-stage camshaft drives and contrarotating balancers, and embraced a perfectly straightforward plan of action. The crank is a one-piece forging carried in plain automotive-type bearings, and the two-piece forged connecting rods have plain inserts to run against the crankpins (the rod's small ends are copper-plated instead of having pressed-in bushings). The crank's right-hand end is the power takeoff; the left end drives the cams and the oil pump. A single-stage chain drive turns the cams, which work the valves, two per cylinder, through inverted-bucket followers—like an Offy, or a Z-1—and valve clearances are set by substituting various thicknesses of follower face discs, exactly as in Kawasaki's big four. Just outboard from the camshaft drive sprocket on the crank extension is a spur gear that meshes with another on a cross shaft, and this gear-set is the first stage of the oil pump drive; it also is driven, through a one-way clutch, by the starter motor. And outside the sprocket and gears is a tang that drives the ignition's contact breaker cam. Nowhere is there two parts where one could be made to do the job, and that's a change from some of the Yamahas of the recent past.

The triple probably could be made to pump out a lot of power, and a factoring of test weight and drag-strip performance says

it's no weakling in its present form. But the engine's nearly-flat-top pistons, willingness to run on almost any fuel, and 276-degrees duration valve timing (with 72-degrees of exhaust-intake overlap) say loudly that the engineering emphasis has been on tractability and long-term reliability. Somebody is sure to start making muscle accessories for the triple before the first hundred leave the dealer's showrooms; Yamaha has decided not to try butting heads with the mighty Z-1, and has pulled just enough power out of the triple to let the bike hold its head up when in the company of other big bikes.

Straight-line performance isn't the XS750's forte, which that won't matter to anyone who understands that there is such a thing as enough. And the triple is fast enough to meet any reasonable requirement for passing or zinging up mountain grades. In any case, its strong appeal isn't in the realm of muscle, but in nicety and finesse. The three-cylinder engine's vibrations, if any, get filtered out by well-engineered mountings and rubber-bushed handlebar clamps. Yamaha has blessed the bike with the smoothest ride this side of a BMW, and it handles more than acceptably within the limits imposed by cornering clearance. It's a good-looking machine, with an air of quality about it that doesn't fade when you subject individual components to close scrutiny. And it's an awful lot of motorcycle for the money. But more than anything else, whatever price Yamaha asks for it, the XS750D is simply very, very nice; a pleasure to ride anywhere, and for any reasonable time. *

SUZUKI 185 *Continued from page 92*

tiny holes to let any excess oil or water escape the box. Fair enough. But Suzuki has not punched the holes in the bottom of the box and let thing go at that—unsightly oil might drop down on the engine. Each hole has its own moulded rubber vent to direct airbox wastes away from the engine. Overkill, you reply. Perhaps that's true, but it's also the kind of attention to detail that makes motorcycles like the Suzuki 185 appealing.

The Ram Air System as used on the 185 differs from the RAS found on Suzuki's 380 and 550 triples. On the larger bikes the shrouds are separate pieces from the actual cylinderheads. On the 185, Suzuki has cast the cylinderheads and "shrouds" altogether. This is probably a more expensive way to get RAS benefits (quieter running, cooler head cylinder temperatures, and better mileage), but it's a very good way.

The 185 logged an average of 44 miles per gallon. This figure reflected a great deal of freeway riding and some brisk backroad miles. In such situations, the engine—which surges forward as it gets on its pipes at 5000 rpm—never spun below 6000 rpm. Whenever a hill threatened to drag the rev-counter down to 6000 in fifth gear, a quick downshift brought 7000-rpm back on the clock. Since the Suzuki ran so sweetly up-range, the tach needle lived almost permanently above the 6000 rpm level and occasionally shot through the redlined ceiling at 8500 rpm. There were no advantages in going through the roof, however; the engine was quite finished at eight.

Forty-four miles-per-gallon meant that the 185 was a short-range motorcycle as tested by Cycle. The main tank was tapped out between 86 and 96 miles, leaving the rider about 20 miles to find a gas station before exhausting the reserve supply. Undoubtedly, had Cycle's testers not thrashed around in a great rush, the 185 twin would have produced better mileage figures; 50 mpg seems likely under moderate operating conditions.

As a 200-class motorcycle, the Suzuki 185 is an impressive machine: a refined, smooth, civil piece of hardware with nary a ragged edge. Light and agile, it has enough power to be a viable short-range commuter and boulevardier. Given good shocks and grippy tires, the bike could be a real backroad entertainer, providing the rider didn't drive the undercarriage into the pavement. Could you ask for anything more? Maybe so.

As a \$1000-motorcycle, up against econo-350/400s, the charm of any 200-class machine fades. Perhaps its features (electric starter, disc brake, etc.) and its natural advantages (weight and agility) still make the bike a reasonable choice for many riders. After all, some people can't kickstart a 350/400 four-stroke twin.

But motorcycling is the name of the game. People call these two-wheeled devices motorcycles, not electric-start cycles or disc-brake cycles or feature-cycles. Consumers have always been willing to pay for motors, and historically larger engines have been more attractive than smaller engines offered at the same price. Those who genuinely like 200cc roadsters must be hoping that history is no flashlight to the future. *

CYCLE