SPECIAL REPORT: 50,000 MILE PEUGEOT TEARDOWN

ROAD TEST

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ROAD TEST SPECIAL TEARDOWN REPORT

PEUGEOT 504 DIE

50,000 MILES WITH THE LIFETIME LION

If you like the Rock of Gibraltar, you'll love the Peugeot 504D; after 50,000 miles, the only way you know it's been driven is by the sandblasted windows

by John Ethridge

PHOTOGRAPHY BY DAVID GOOLEY

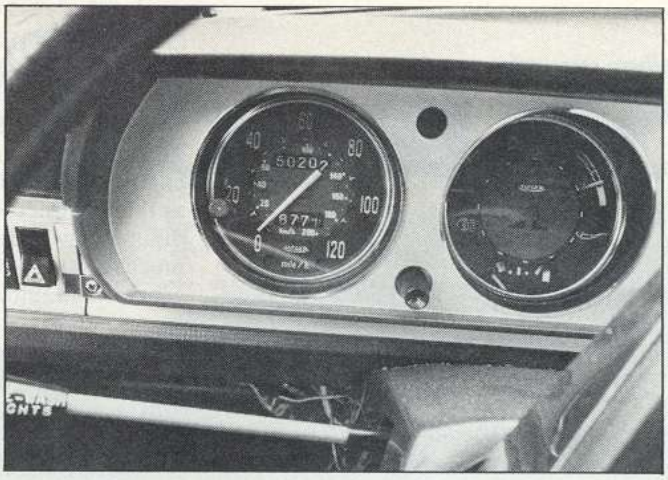
CSEL

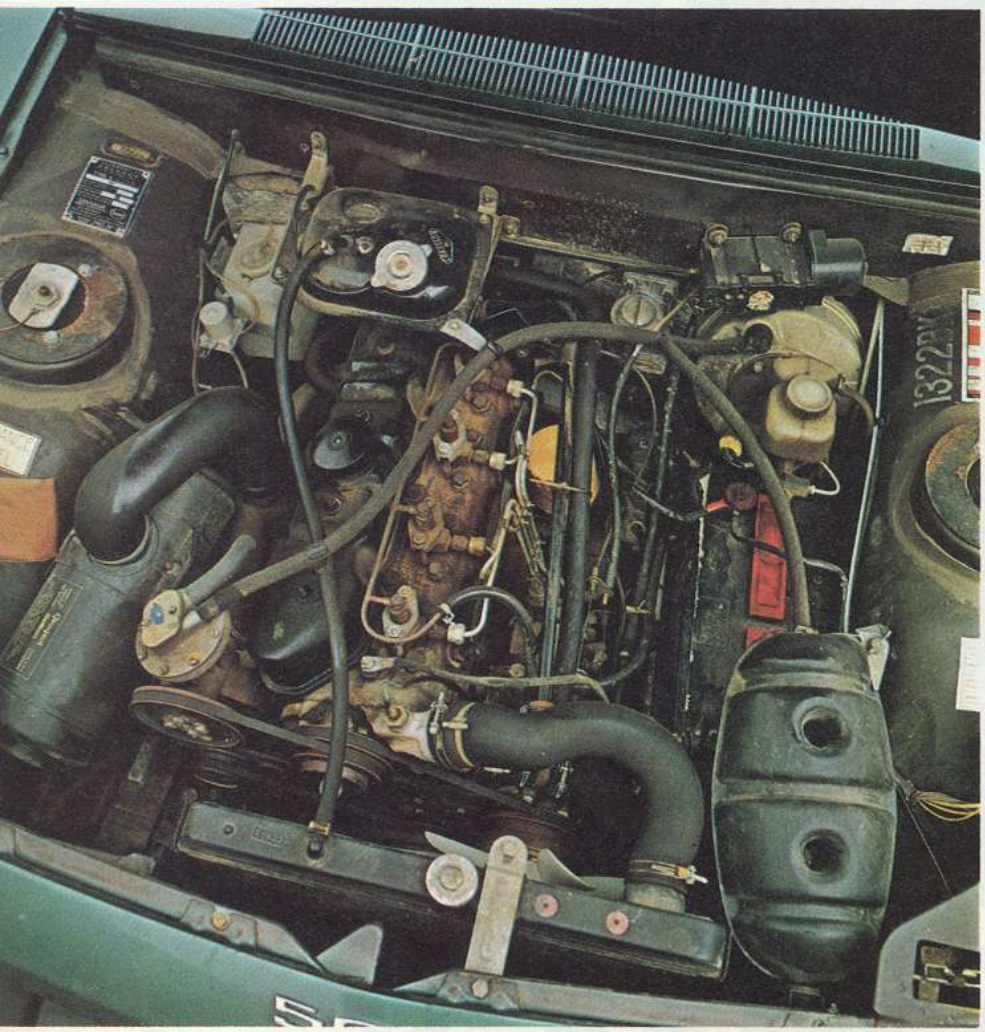
□ Since performance, fuel consumption and the oil used between changes were virtually unchanged from what they were at break-in, we didn't expect to find anything seriously amiss with the 504 diesel engine after 50,000 miles of driving. And, as things turned out, we were correct, but disassembly and inspection were still very much of an adventure because of our general unfamiliarity of just what *does* happen to a diesel passenger car engine as higher mileage accumulates.

But before getting into the nuts and bolts of things, we will recap what the test was all about for the benefit of readers who may have missed our interim reports given from time to time as testing progressed. Our test car was a 1974 U.S. model Peugeot 504 diesel four-door sedan that fully met all federal bumper, struc-

tural and crash standards. The bumpers and beams in the doors upped the curb weight 275 lbs. over the European model we tested (March 1974 *Road Test*) and noticeably affected acceleration.

After approximately 10,000 miles of general driving by various staff members, the car was turned over to Uniroyal, which kindly agreed to put the bulk of the mileage on the car under very carefully controlled and documented conditions at its Laredo, Texas, proving grounds coincidental with testing Uniroyal tires on the car. For purposes of this phase of the test the 3055-lb. car was ballasted to a total weight of 3515 lbs. to simulate a three-passenger load. Approximately 30,000 miles were put on the car in 371-mile shifts broken down as follows: 173 miles at 55 mph maximum, 3 miles at 35 mph maximum, and 195 miles at 65 mph maximum. The mileage included stop-and-go, turnarounds, lunch and fuel stops, and the slower (55 mph and under) driving was done mostly on public two- and four-lane highways and access roads.



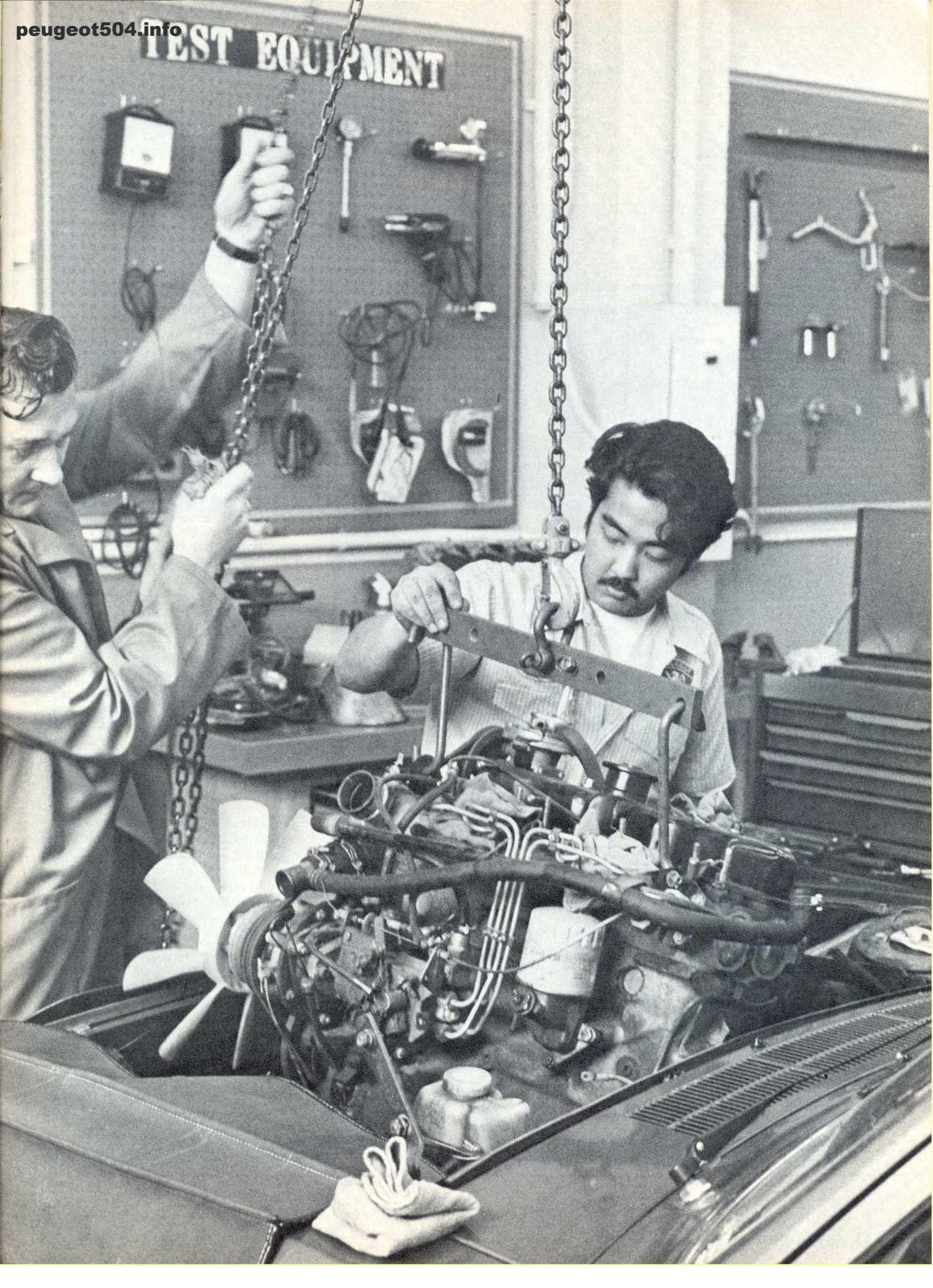


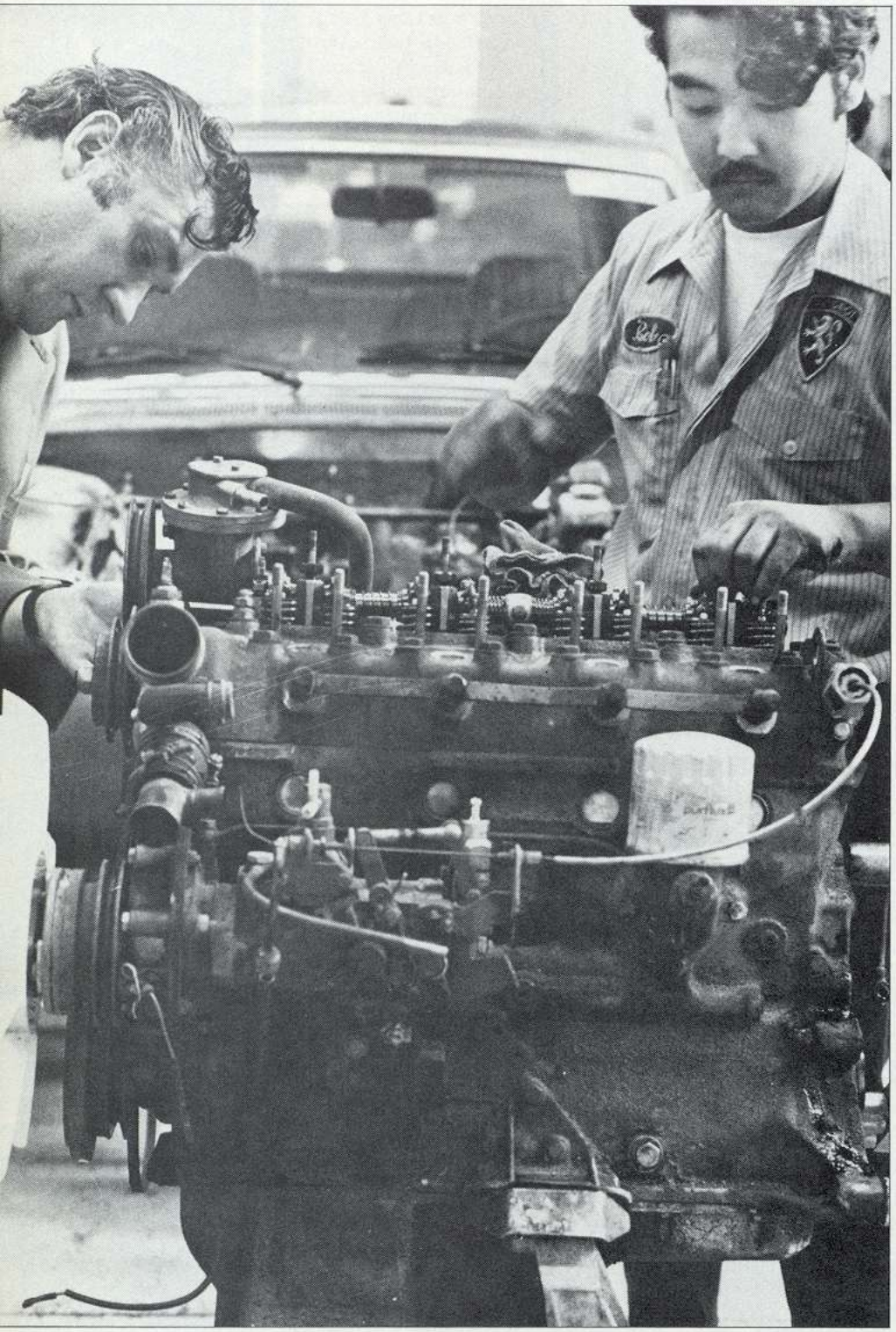
504 diesel arrived at teardown appointment with generous layer of sand atop engine, thanks to Palm Springs, California sandstorms.

Uniroyal records for this phase of the test show that the car was serviced a total of 20 times (lubrication, oil change, filter change at every other oil change). On two occasions a quart of oil was added just when the oil was due for a change, so these additions were not considered valid. Fuel mileage with the simulated three-passenger load, corrected for a one percent odometer error, was 28.08 mpg overall. (Highway mileage with just a driver aboard averaged 30–31 mpg and remained virtually the same near the 50,000-mile mark as it was when the car was new.)

Near the conclusion of the test the car was caught in one of Palm Springs, California's, notorious sandstorms resulting in severe pitting of the windshield and frosting the headlamp lenses and the glass in the outside rearview mirror, but the paint held. And although the engine and engine compartment looked as if someone had piled sand in with a shovel, the various filters provided complete protection for the fuel system and engine.

Troubles with the car were few and minor. The driver's window got off its track and had to be re-hung, probably as a result of the workout the window mechanism received in the hot, humid southern Texas climate. (The car wasn't equipped with air conditioning.) On three or four separate occasions the car had to be started with a booster battery, and the





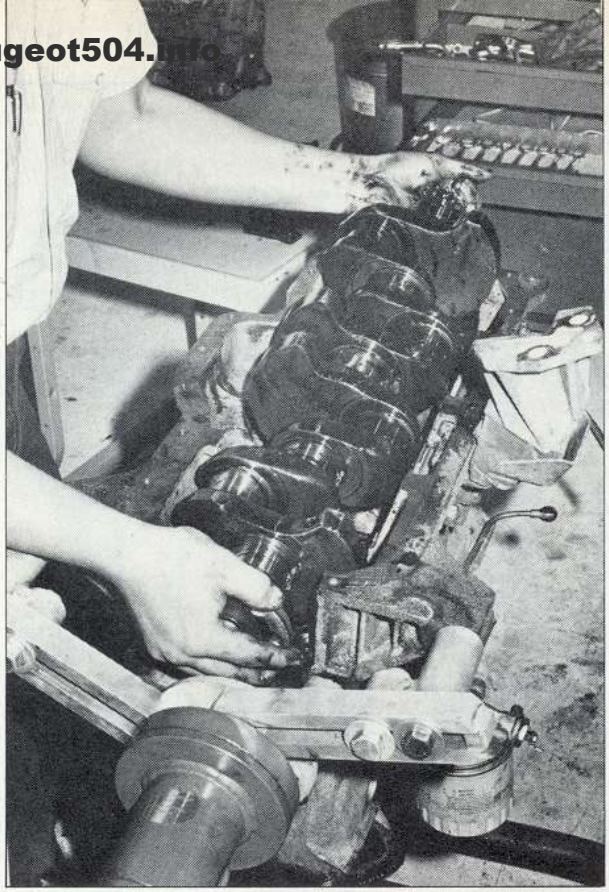
cause was ultimately traced to corrosion at the battery terminals. (The terminals are of such a design that corrosion can't readily be seen without disconnecting them.) One of the sealed beam headlamp units failed at 33,622 miles, and the windshield wiper blades wore out as a result of rubbing on the pitted windshield. And that was the total of unscheduled maintenance for the 50,000 miles.

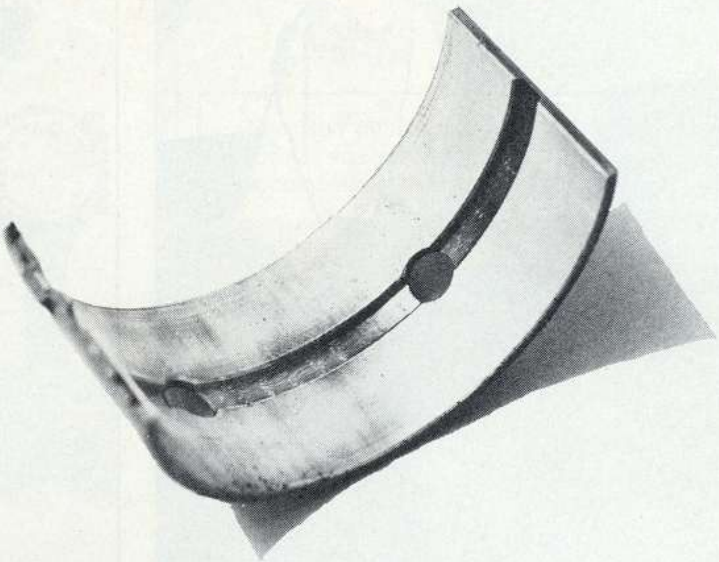
Before tearing the car down it was given a final test drive and a careful inspection. Not one whit of the good ride was lost, and the steering was still light and without any slackness whatsoever. Braking action and clutch operation were unchanged, and the gearbox shifted the same as it always had. In short, the car drove and felt the same way it did at the start of the test.

The fuel injectors were removed (remove 2 bolts and disconnect pressure and return lines) and compression readings were taken. The readings, in bars (which we will explain later) were as follows: Cylinder #1 (nearest firewall by Peugeot's system)—36; #2—36; #3—35; #4—34, which compares to a newly broken-in engine's typical reading of 38–40 bars and well within the service limits for the engine. (A *bar* is a unit of pressure in the centimeter-gram-second system defined as 1,000,000 dynes per square centimeter which turns out to be just slightly less than 1 standard atmosphere or 14.6 psi; 1.0132 bars equals 1 atmosphere to be exact. So multiplying the reading in bars by 14.4 will convert it into psi.)

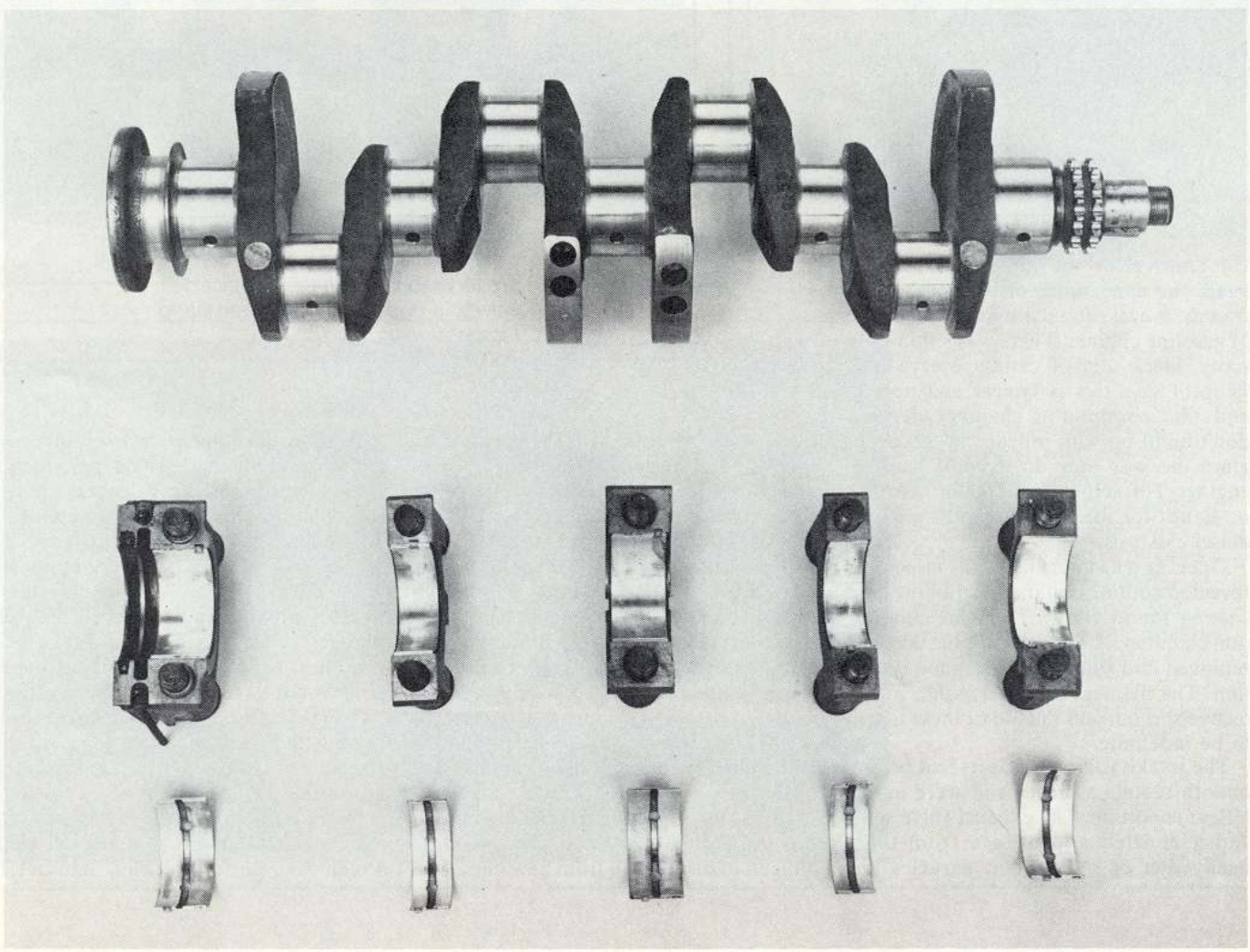
The injectors themselves were then bench tested for proper functioning. This consisted of a visual check of the spray pattern (all were symmetrical and uniform) and measurement of injection pressure (all within a few psi of the specified value). A ragged spray pattern, Peugeot technicians say, usually means that either critical parts are worn or that dirt or other foreign material has found its way into the injector. Also, had the pressure been out of specification for any reason, overhaul and/or shimming to the correct value is a fairly simple and straightforward operation with the aid of the bench tester.

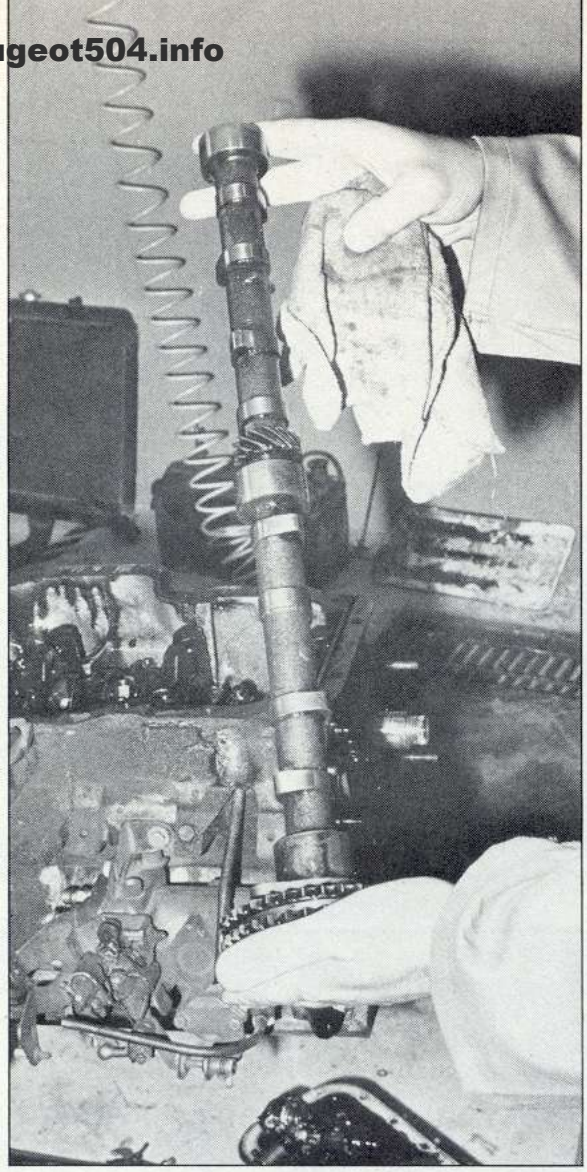
The engine was then removed from the car and placed on a stand for disassembly.

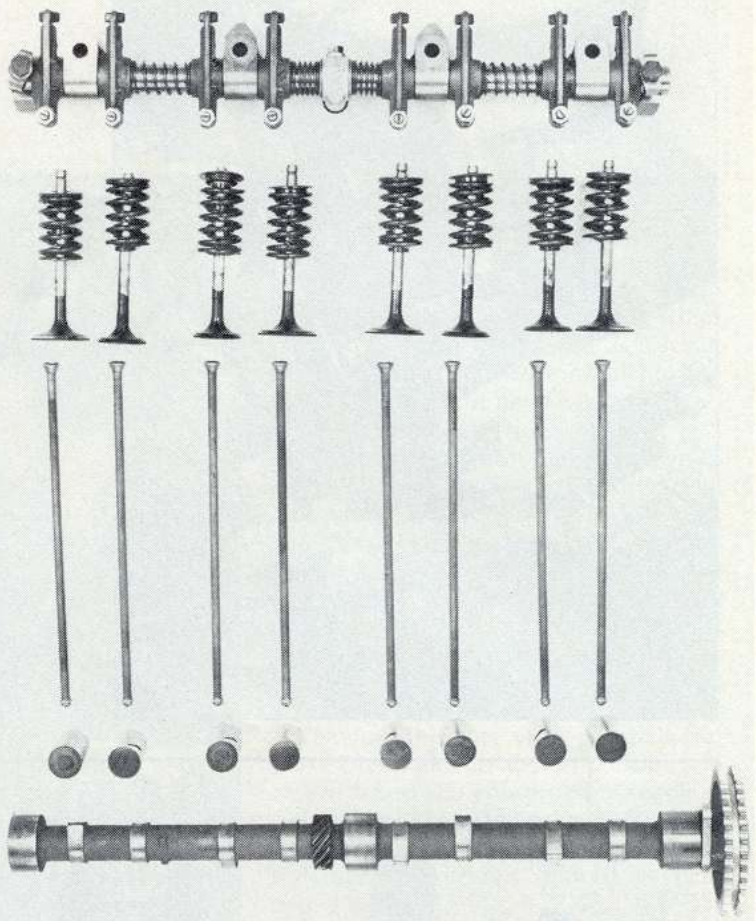




Crankshaft and bearings were in excellent shape, which is attributed to 1500-mile oil change interval.







Lightly stressed valve gear exhibits no appreciable wear. Marked state of preservation of exhaust (smaller) valves is due to their low operating temperature.

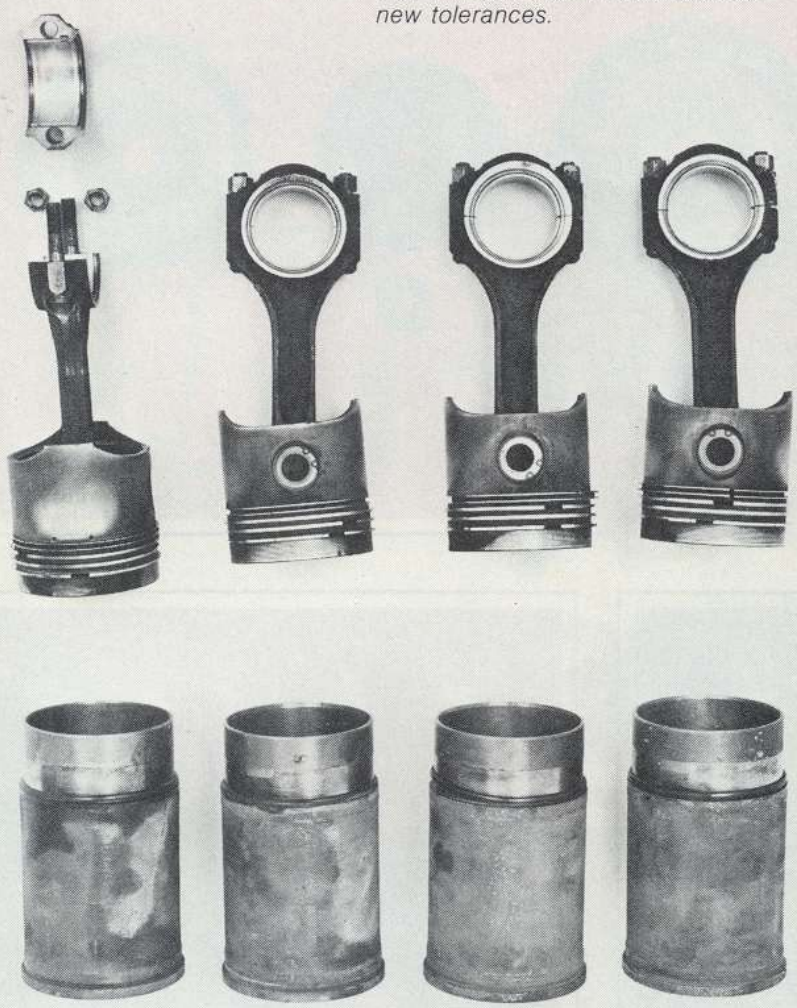
On removal of the aluminum cylinder head, the appearance of the combustion chambers was quite different from that of gasoline engines. There was a thin, soft, sooty, black film of carbon everywhere. Peugeot says this is typical and normal and that combustion chamber deposits don't build up with mileage in diesel engines the way they do in most gasoline engines. This self-cleaning action accounts no doubt for the smoke seen at times in diesel exhausts.

Opening a swirl chamber for inspection revealed nothing remarkable, just the dark coating found elsewhere in the combustion chamber. A Bosch glow plug was also removed and found to be in good condition. The filament is sealed within a protective shroud, and the life of these is said to be indefinite.

The intake valves and seats had bright, smooth seating surfaces and were in excellent condition. The exhaust valve seats had a mottled appearance from their steady diet of soft carbon particles but little in the way of actual wear and no indication of burning. The exhaust valves present a markedly different appearance from their counterparts in gasoline engines of this mileage. They are dark and look as if they've never been hot, whereas those from gasoline engines are brownish-red because of the much higher exhaust gas temperatures. All valves were found to be snug in their guides and there was no evidence of loss of oil through the guides.

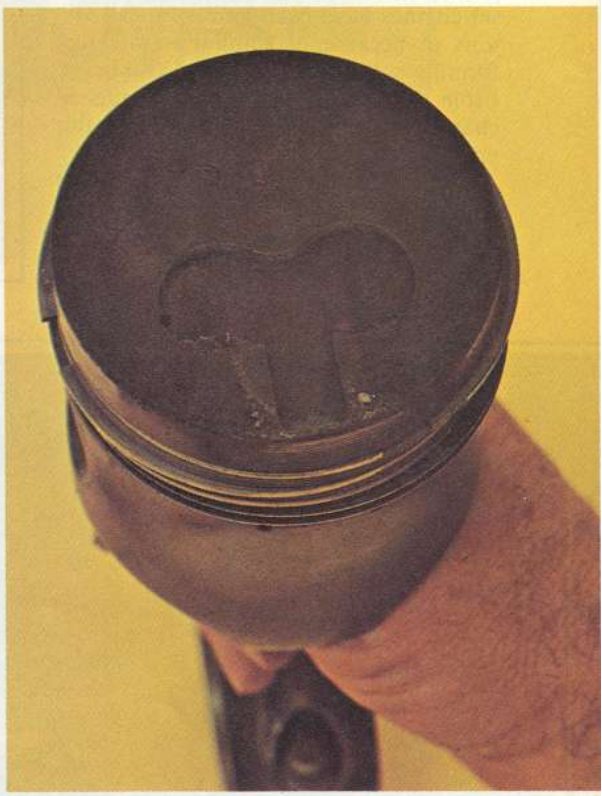
The valve lifters, which incidentally are removable via cover plates on the side of the block without removing the camshaft, were perfectly flat on the surface that contacts the cam lobes and would be difficult to distinguish from new ones. The cam lobes and bearings were in perfect condition. The timing chain, as evidenced by the position of the tensioners and by lifting it by one end and observing the lateral droop, was as good as new. The tensioners and sprockets were in likewise good health. There was no play in the injector pump bearings, and the injector plungers were reckoned to be in good condition because the running of the engine would have noticeably been affected had they been otherwise. (Diesel injector pumps traditionally render long, trouble-free service because the fuel is an effective lubricant.)

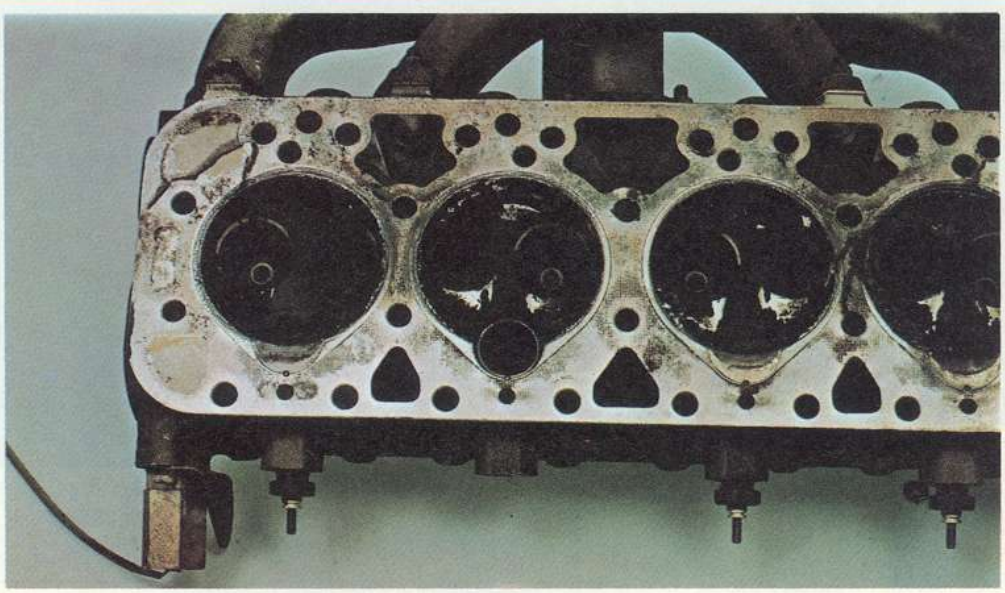
On examination of the lower end of the engine it was found that the oil pump screen was perfectly clean, unusual for



Piston assemblies, wet-sleeve cylinders barely showed signs of use, and in most critical areas retained new tolerances.

Thin, soft deposits on piston top are normal and represent maximum accumulation regardless of mileage.

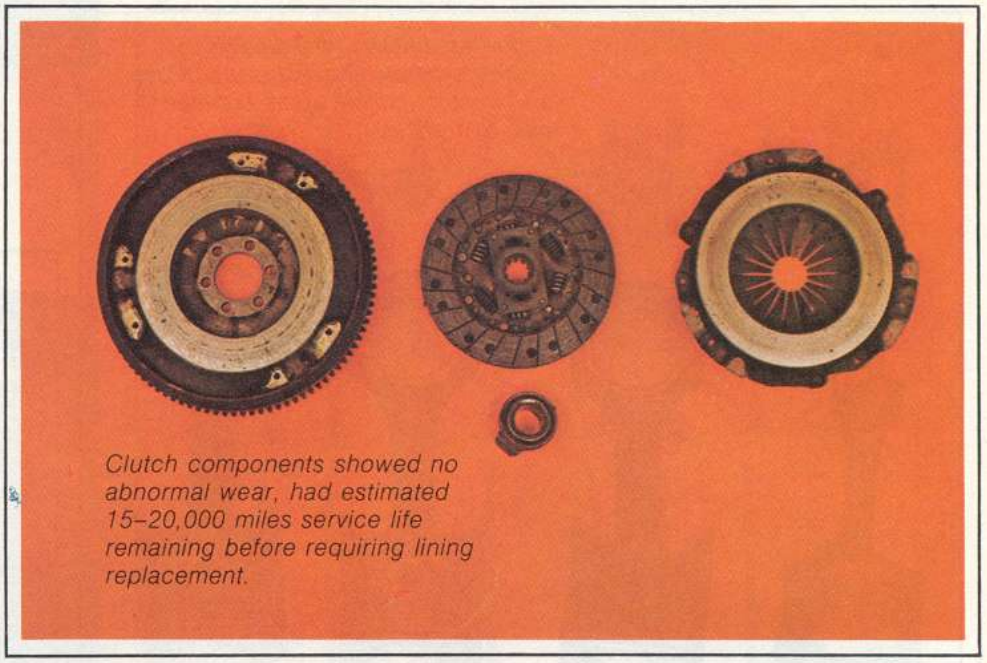




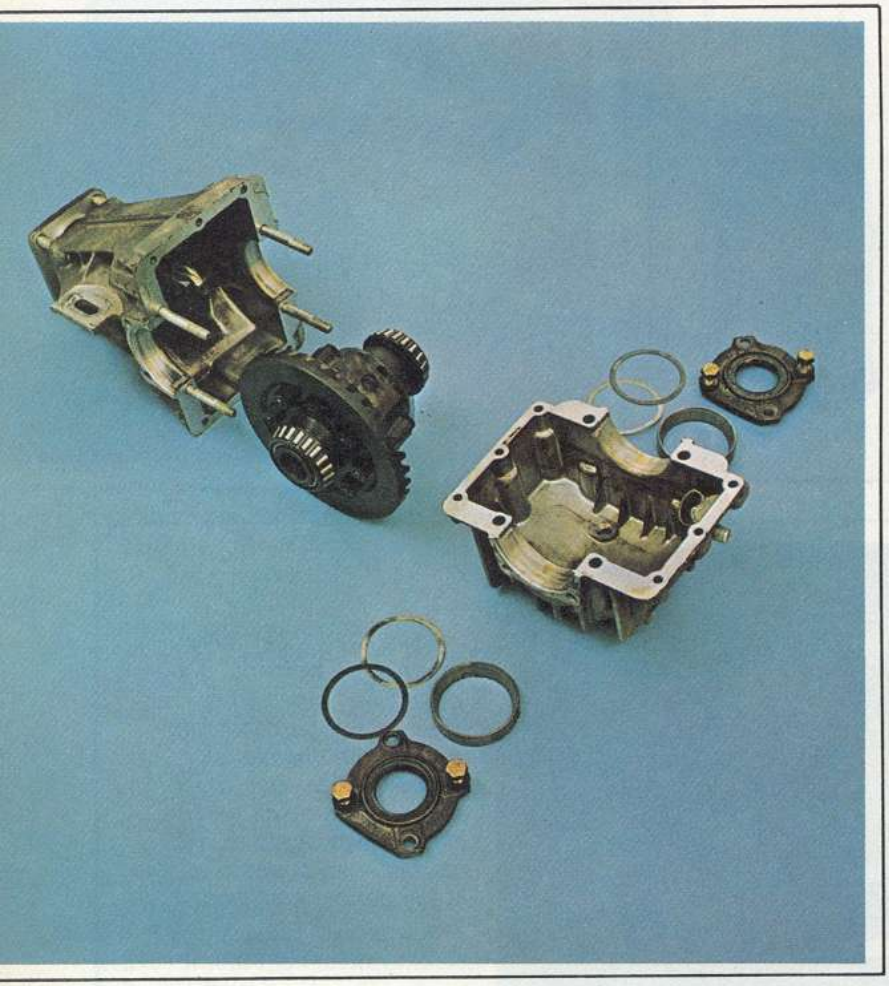
Aluminum cylinder head was free of warpage, and gasket was intact. This layer of soft carbon coated combustion chambers. Mottled appearance of valve seats is due to soft carbon flakes. Swirl chamber and glow plug were also blackened but in perfect condition.

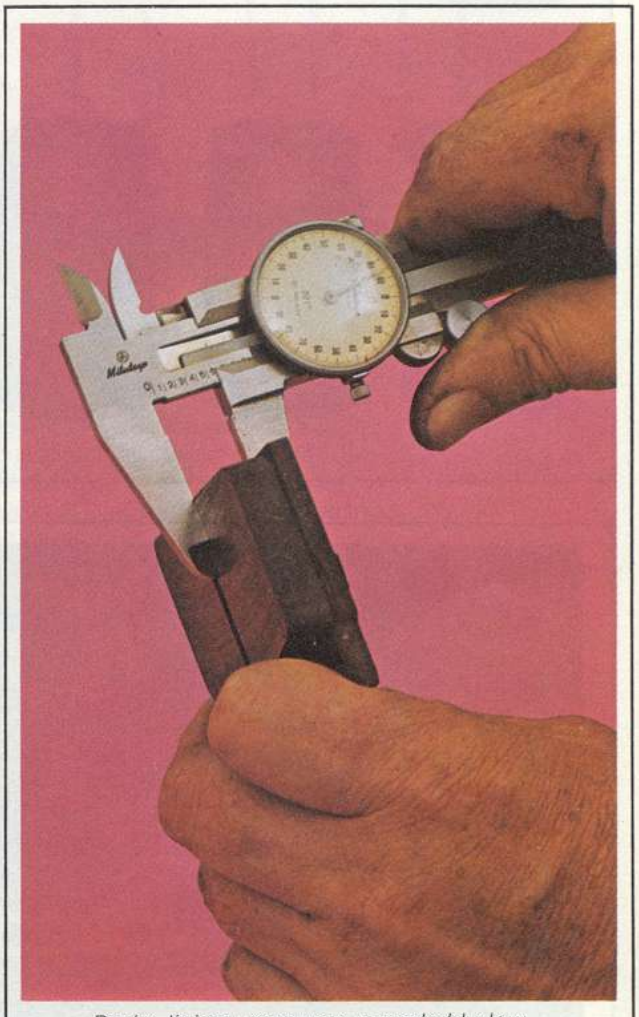
engines of this mileage which usually have at least a flake or two of solid matter on the screen. The oil pump was in flawless condition, showing no evidence of having circulated metal flakes or other abrasive material. The main and rod bearing inserts were in unbelievably good condition. Other than small burnished areas on two of them that were on the low side of the clearance tolerance they look as if they had just been removed from a new parts box. There was absolutely no sign of the greatly feared bearing corrosion that diesel engines have been known to fall victims to because of sulphur in the fuel forming sulphuric acid in the crankcase. From all appearances the 1500-mile oil change is an effective antidote for this problem.

(The 1500-mile oil change has been widely questioned by Peugeot diesel owners and others as maybe overdoing things a bit. As a consequence, Peugeot

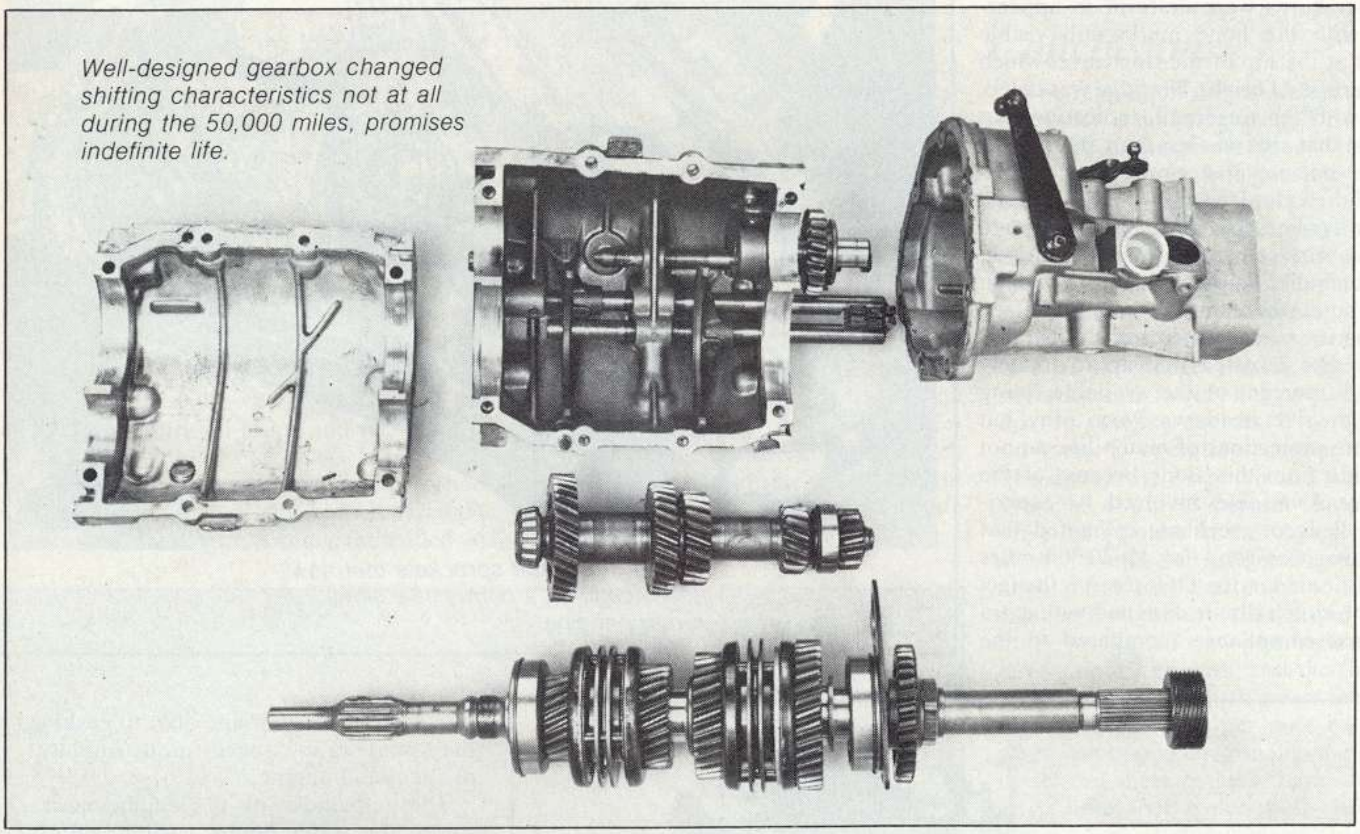


Clutch components showed no abnormal wear, had estimated 15–20,000 miles service life remaining before requiring lining replacement.

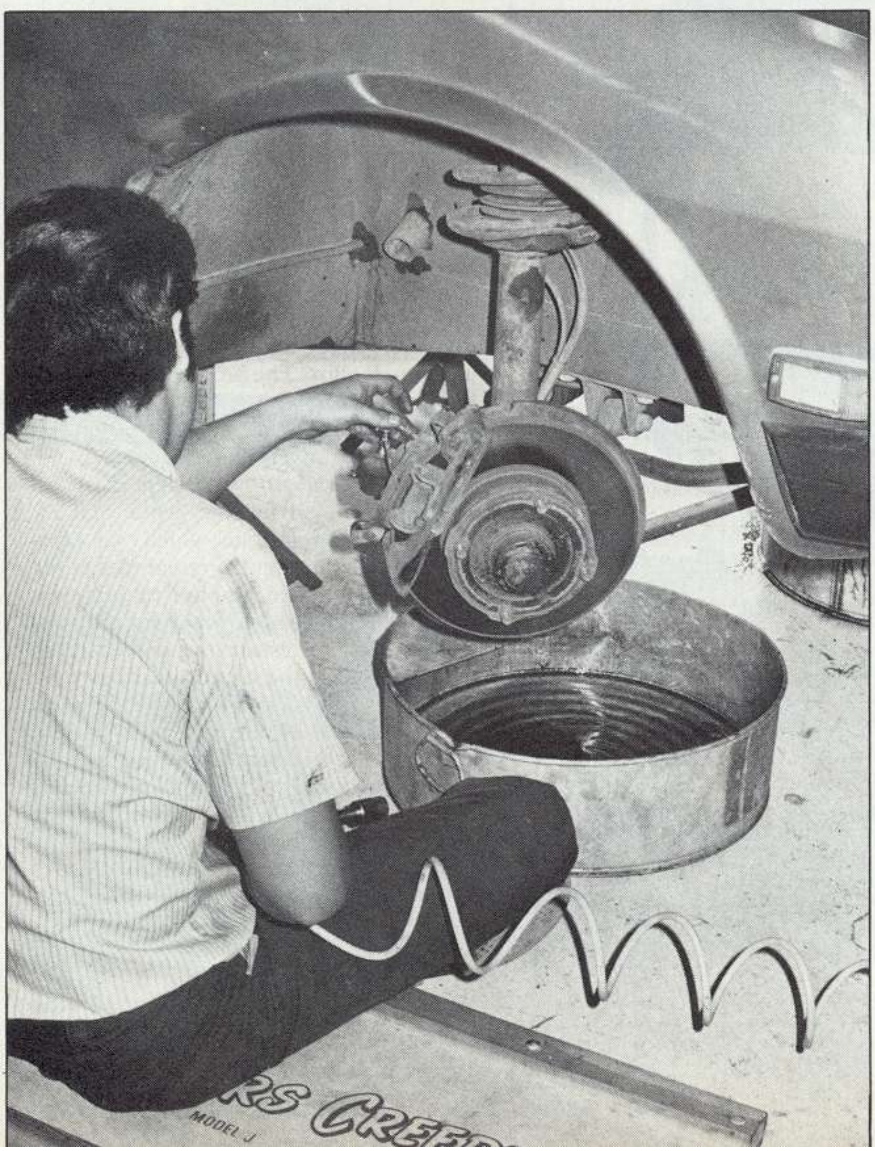




Brake lining wear was remarkably low considering 30,000 of 50,000 miles was with simulated 3-passenger load.



Well-designed gearbox changed shifting characteristics not at all during the 50,000 miles, promises indefinite life.



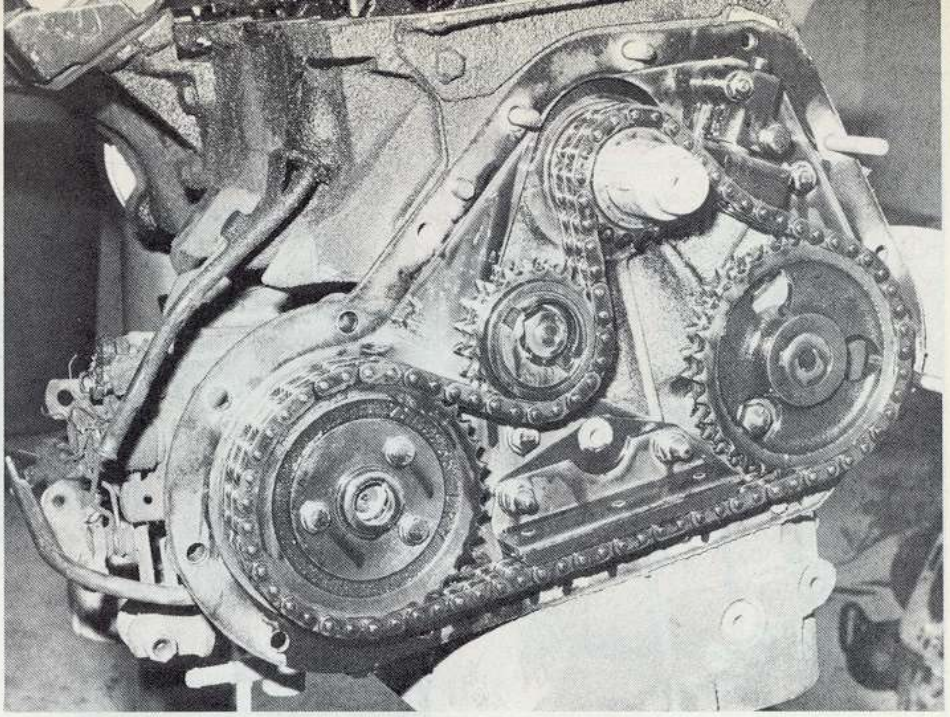
technical people in this country took oil samples at intervals on company diesels and had them analyzed by an independent laboratory. And sure enough, at around 1700 miles, the lab tests showed that the oil became unserviceable. Peugeot deserves credit for being realistic and truthful rather than joining the trend to ever-increased oil change intervals. For those owners who range far afield where there are no dealers, or those who object to paying shop labor rates for what gasoline stations will do free, Peugeot suggests picking up a supply of oil filters from a dealer and keeping a log and receipts of the changes for warranty requirements. They will, in fact, accept for warranty purposes records of owners who change oil and filters themselves provided they show receipts for the oil and filters and the dates and odometer readings when the oil and filter changes were performed.)

As expected from the condition of the bearings, the crankshaft bearing journals measured to new tolerances.

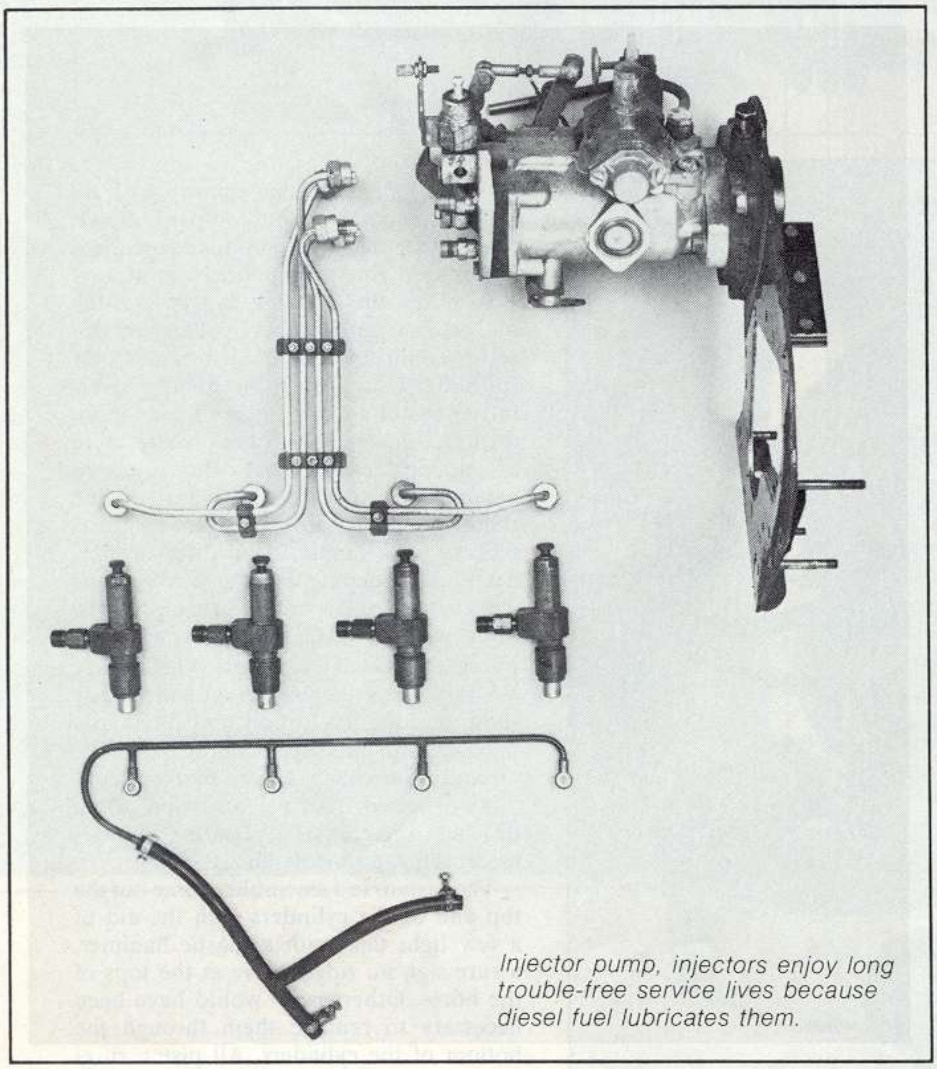
The piston/rod assemblies came out the top end of the cylinders with the aid of a few light taps with a plastic hammer, a sure sign no ridges were at the tops of the bores. Otherwise it would have been necessary to remove them through the bottom of the cylinders. All piston rings were free in their grooves, and the wrist pins were snug in the pistons and rods. The cylinder sleeves were removed from

the block for inspection, noting that the bottom seals were all intact. The four cylinder bores were uniform in appearance with the hone marks still visible except at the top of the ring travel which was burnished bright. No ridge was detectable with the fingernail, indicating that wear in that area was less than .001 inches. There was no evidence of scoring or galling of the cylinder walls.

The flywheel and clutch pressure plate friction surfaces were perfectly smooth, the clutch disc lining having not yet worn to the point where the rivets made contact. Comparing measurements of the old and a new disc revealed that approximately 40 to 50 percent of the available lining above the rivet heads was worn away, but absolute projections of clutch life cannot be made from this alone because of the number of variables involved. An experienced Peugeot mechanic estimated that the lining was good for 15–20,000 miles of additional service. Of interest is the fact that the clutch disc is designed with extra torsional compliance (compared to the disc used in the gasoline 504) to cushion the thumping low speed torque impulses of the diesel engine.



Timing chain and sprockets met new specifications, a bonus of a slow-turning engine.



Injector pump, injectors enjoy long trouble-free service lives because diesel fuel lubricates them.

The remainder of the engine accessories, the water pump, vacuum pump, starter and alternator were not remarkable except that they all appeared to be in good serviceable condition.

All transmission components, bearings, gears, synchromesh mechanisms etc. were completely unscathed and gave the impression that, so long as there is lubricant in the gearbox, they are capable of rendering indefinite service. Instead of the small-diameter bronze synchro conical clutches seen in most gearboxes, this one uses conical clutches of a much larger diameter, made of steel and faced with aluminum alloy. The bronze clutches used in some gearboxes are brittle and prone to breakage, but the Peugeot design appears comparatively indestructible.

The final drive unit's left axle shaft seal developed an oil seepage while at Uniroyal's proving grounds which was carefully watched during the remainder of the test. But the actual amount of lubricant was so small that none was ever required to be added to restore the proper level. On disassembly the carrier bearings were found to be in good order, and the tooth contact pattern on the ring gear showed ideal pinion engagement. The generally robust dimensions of the final drive gears give the impression they are capable of handling much larger engines than any Peugeot has used.

The packings on the axle shaft joints

were all intact, and the joints themselves were free of excessive play. The diagonal pivot rear suspension (which just about all of the better European cars now use) is sturdy and lowly stressed at the attachment points, so there's virtually nothing that could go wrong with them. Both rear shock absorbers and the ones in the MacPherson struts at the front were dry around the shaft seals and in perfect working order. (Peugeot technicians say that they normally go for 100,000-plus miles before needing replacement.) The front suspension components were all sound as were all joints and the steering linkage.

Although the front disc brake rotors had visible markings of the kind that might result if some grit became imbedded in the linings, they could hardly be felt so small was the amount of wear. The front linings had worn only .06 inches out of a possible .38 inches to the bottom of the groove in the lining. The rear rotors weren't marked like the front, and the rear linings were worn only .01 inches out of a possible .37 inches to the bottom of the groove. The projected life of the front linings is 6 times the distance of the test, and that of the rear linings boggles the mind. This is due in part to the generous swept area of the four-wheel discs and in part to the excellent compression braking afforded by the diesel engine when descending grades. Brake wear, like clutch wear, is subject to lots of variables, but these brakes indicate excellent service life even under severe conditions.

Important phase of test was handled by Uniroyal technicians at their Laredo, Texas proving grounds.

Conclusions

The reputation diesel engines have for durability is no mere myth. This one not only has a maximum speed 1500 rpm lower than equivalent gasoline engines, but its low-speed torque characteristics allow shifting into higher gears at lower engine speeds, resulting in less engine revolutions per mile. Low engine speeds cut frictional losses and wear, visibly so on certain valve gear components in the case of the Peugeot. Also, the thermal stresses are far lower on the exhaust valves than in gasoline engines.

Neither is operating economy a myth. The diesel fuel we purchased for the test averaged about 18 percent less than the price for gasoline in the same locality or about 10 cents per gallon. There are only about three cars that come to mind for sale in this country that promise more miles per gallon on open highways. All have gasoline engines, and the fuel price differential pretty much erases the advantage on a fuel cost per mile basis. And when it comes to city driving, the Peugeot diesel can meet or beat these same cars on a miles per gallon basis because a diesel's fuel economy doesn't drop way down in town the way gasoline engines do. And it might be added that no car near its size and weight or offering the same room and comfort can hold a candle to it in the area of fuel economy—except of course another diesel.

The Peugeot's chassis and suspension rank with the best designs available in the world today. There are striking similarities in technical specifications between the Peugeot chassis/suspension and those of BMW, Mercedes and the Porsche 911 series. And nowhere in the bone, sinew and muscle of the Peugeot can be found the slightest bit of corner-cutting to enable it to sell for thousands less than the above named cars. Yet somehow it does.

Judging from what we have observed during this test and teardown, owners of the Peugeot 504 diesel that service them by the book can have full expectation of watching their odometers turn 100,000 miles without having to do anything major to the car except replacing the clutch. And all can be absolutely certain that they will never replace plugs and points, or have to have a carburetor overhauled, replace a catalyst, or risk a ticket for malfunctioning emissions controls.

The concept of a lifetime automobile is a great one, and if *any* car should be on top of the short list of those cars, the Peugeot 504 diesel is it. ■