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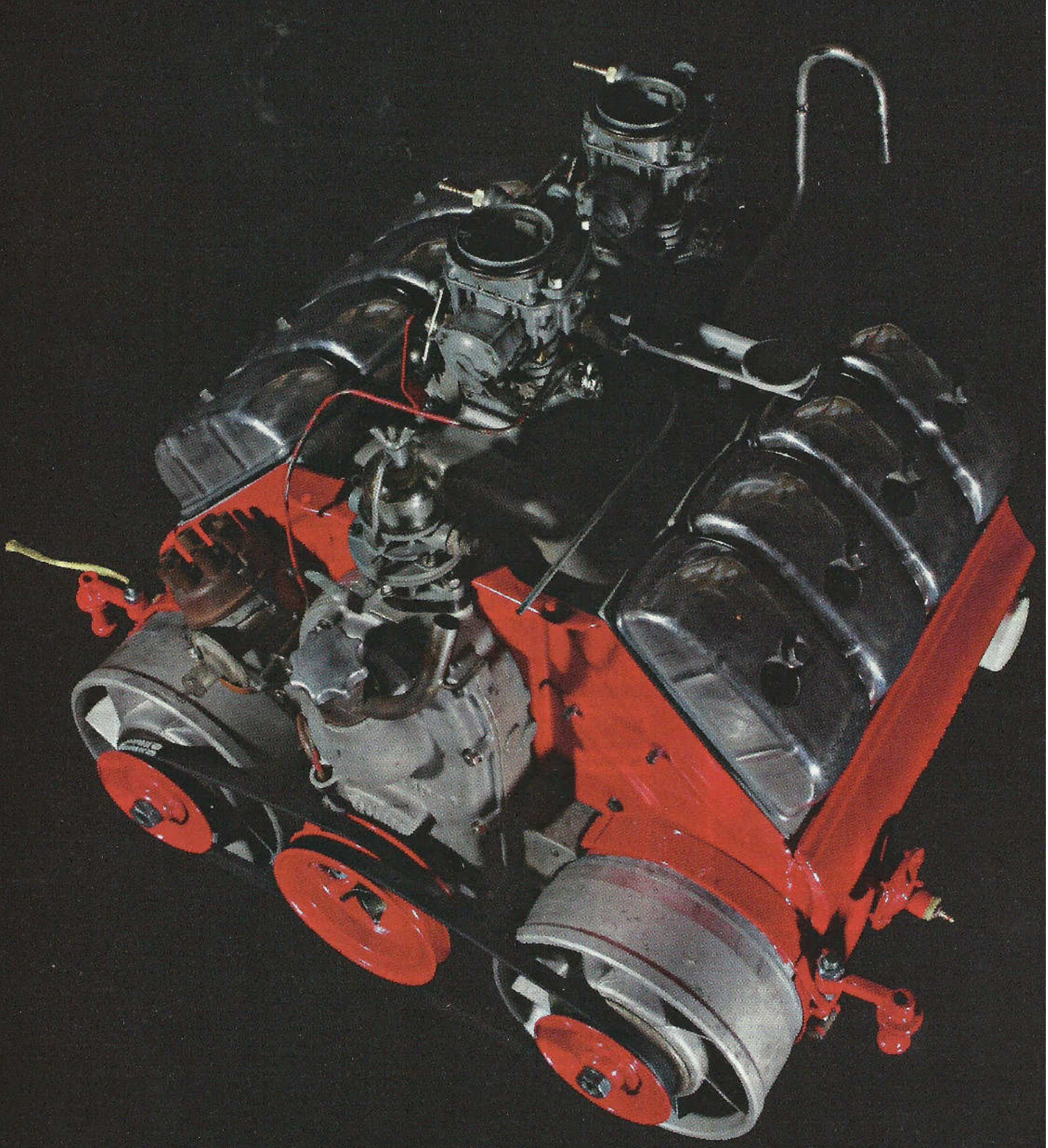


ENGINES THAT MOVED US

TATRA 603 V8

It's one of the greatest engines you've never seen – a compact 2.5-litre air-cooled V8 packed with intriguing features and used in everything from trucks to racing cars. It's Tatra's marvellous 603

WORDS NIGEL BOOTHMAN PHOTOGRAPHY LYNDON MCNEIL

Think of a large, stylish, utterly unmistakable saloon launched in 1955. Today it's regarded as an all-time classic because it was as technically interesting as it was comfortable, as striking as it was unusual. It must be the Citroën DS, surely? But there is another answer – the Tatra 603. It's still obscure almost everywhere outside Germany and other parts of central and eastern Europe, and even there it's not exactly common.

The 603 followed a theme created pre-war by the great name forever associated with Tatra, Hans Ledwinka. Streamlined, spacious and with swing-axle independent rear suspension, it was powered by an air-cooled V8. But that was where Ledwinka's influence ended. He was imprisoned from the end of the war until 1951 after being accused of collaborating with the Nazis (he was posthumously exonerated by the Czech Government in 1992). Freed at the age of 73, his energies were seriously diminished.

So it fell to a gifted engineer called Julius Mackerle to look after the 603 project when it got under way in 1953. At the heart of the new car (or more accurately at the rear) was a 2.5-litre V8 that Mackerle had started designing in 1948 as the powerplant for the small T805 four-wheel drive truck.

The detail work to convert it for use in a car use was done by another talented engine man, Jiri Klos. Klos had an intriguing way of assessing the changes he made – he fitted the engine into a single-seat racing car called the T607 where small changes in performance were highlighted much more clearly than in a ton and a half of off-road truck. And the T607 was more than a mere test-bed – it was a successful racer too. Klos altered the cam profile, compression ratio, carburetion and air flow to raise output from about 75bhp to around 100bhp in road use, or more like 200bhp @ 7500rpm in alcohol-burning race trim.

The V8 was so compact it fitted into the flat-four T600 Tatraplan's engine compartment. An aluminium-bodied two-door version, the T601 Monte Carlo, was fitted with a V8, as were Tatraplans used by the police and the secret service.

So the new engine had quite a career before appearing in the car it was destined to power until 1975. It represented the state of the art for V8s in its basic layout – oversquare with a bore a couple of millimetres larger than its stroke, 90 degrees between the cylinder banks, hemispherical combustion chambers with central spark plugs, a cross-plane crank and a camshaft in the middle of the V, operating the valvegear via relatively short pushrods. And remember, this was before 1950, when no American engine combined all these features and Edward Turner's hemi-head Daimler V8 was still ten years away.

All this made the engine impressively advanced but not particularly unusual. But there's more – the 603 engine is air-cooled. The previous large Tatra car engine, from the T87 designed under Ledwinka, was also air-cooled and on the face of it overhead camshafts made it even more advanced. But it was also larger and heavier than the 603, despite using an Elektron magnesium alloy crankcase, and a lot more expensive to make. The T87 engine's lower compression ratio and single small carburettor also made less power than the 603, despite displacing 500cc more.

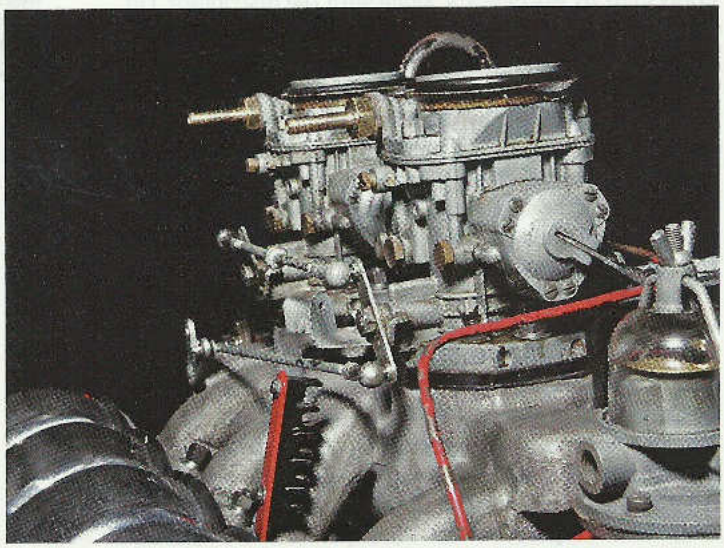
Perhaps most significant was the 603's greatly increased cooling capacity: the T87 offered 1190sq cm of cylinderhead surface area compared with the 603's 2130sq cm. This was achieved by using heavily-finned cast aluminium 'heads and cast iron cylinder barrels with 1mm fins machined into them 3-4mm apart.

As with any air-cooled engine, airflow is crucial. The engine is enclosed within a pressed steel shrouding from which two axial scavenge fans exhaust air that has entered past the carburettors and induction side of the 'heads, keeping the inlet charge cool and therefore dense, increasing volumetric efficiency. Scoops on the T603's rear wings direct air into the engine compartment and the hot air from the fans leaves via thermostatic flaps through a slot in the bumper. The flaps recirculate warm air during warm-up, speeding the process.

The barrels are mounted on an aluminium crankcase, but at the other end the cylinderheads don't straddle all the barrels on one bank, as they do on a VW flat-four or Porsche flat-six. Instead there are four individual cylinderheads on each side. If that wasn't odd enough, there are no 'head gaskets: instead the seal relies on a clean, true mating face and a minute amount of 'squish' in the aluminium 'heads.

The 603's ancillaries are unusual too. The dynamo is hidden in the left fan (as viewed from the rear). This means

BELOW LEFT The red cooling shroud hides the cylinder barrels but not the oil cooler that bolts to the side of the sump, or the modern replacement oil filter BELOW RIGHT Paired twin-choke carburettors on a high-rising manifold allow good breathing, yielding high performance for the era



you know if the left fanbelt breaks (there's one for each fan) because the ignition light comes on. But what about the right fanbelt? Unless you're in a rare VIP model with a dynamo in each fan (high-ranking Communist Party passengers couldn't let a simple fanbelt failure leave them to the mercy of James Bond types with loaded Berettas) you'd have no warning until the uncooled bank of cylinders fried and the engine seized. Or at least you wouldn't if Tatra hadn't put an air pressure switch into the fan body. This extinguishes an orange light on the dash, warning you instantly of a broken belt. Clever details like these are at odds with the crude reputation of many Eastern Bloc cars.

On the topic of cooling, it's worth examining the oil flow, which is moved by a gear-type pump driven from the crankshaft by worm gears, along with the distributor. Oil passes through large horizontal coolers bolted to either side of the sump (entering and exiting through hollow fixing bolts, cleverly avoiding the need for further oil unions) and in theory is cleaned by passing through an aluminium casting containing a stack of metal gauze discs, which are meant to be removed and cleaned at service. The oil then emerges from the side of the crankcase near the flywheel.

In practice, though, it's difficult to remove debris from the oil and nowadays a converter allowing you to fit a modern spin-on filter is a good option. It's one of several challenges this engine can present to owners, as Tatra Register UK chairman and 603 owner Ian Tisdale explains: 'The oil coolers are vulnerable to being struck and damaged by clumsy use of a jack. They're just soldered together and can also fracture with age, due to continuous expansion and contraction and to their cantilevered mounting. Another source of oil leaks is the pushrod tubes, which have a rubber seal top and bottom. These perish and are more of a pain to fix – you have to take out the engine and remove the cylinderheads.'

It looks like any other V8 at first glance – but peer closely and you'll see there are eight separate cylinder barrels, each with its own cylinderhead

1968 Tatra 603H

2472cc, V8, ohv, two twin-choke Jikov 30 SSOP carburettors
Bore 75mm **Stroke** 70mm
Power 105bhp @ 4800rpm
Torque 123lb ft @ 4000rpm
Weight 160kg
Length 580mm
Width 618mm (excluding shroud)

More profound problems can be caused by failing to understand the clever design of the main reciprocating parts. The gudgeon pins are offset in the pistons, a design common to many slant and V-formation engines that offers a major benefit associated with reducing the stresses encountered in a typical piston engine. One undesirable stress in the four-stroke cycle is the 'scuff' inflicted by the piston on one side of the cylinder wall during the ignition stroke as it's forced down the bore. Picture a V8 engine, end-on, with the crank rotating clockwise; look at the right bank of cylinders – as a cylinder fires, the piston is pushed down the bore and the con-rod assumes an angle in the cylinder instead of being vertical. This naturally shoves one side of the piston into the cylinder wall. But offsetting the gudgeon pin reduces this angle, so the 'shove' is less too.

That's all very well as long as you fit the pistons and con-rods the right way round. Putting them in backwards naturally multiplies the thrust and friction rather than reducing it. 'If you're standing at the back of a 'headless engine, all the arrows cast into the piston crowns should point to the right, following the direction of rotation,' explains Tisdale, who once discovered that all the piston and con-rod assemblies on one bank of a 603 engine had been fitted the wrong way round.

The pistons have a slot machined into the skirt on the unstressed side (the side away from the friction caused during the firing stroke). This allows them to pick up some oil splash during the bottom of each stroke and keep the bore lubricated, but it also contributes to balance as the offset gudgeon pin means there's more 'meat' on the unstressed side of the piston.

One aspect of 603 engine ownership that would be amusing if it wasn't so serious is the interchangeability of older and newer parts and the problems this can cause with eight separate cylinder barrels and cylinderheads. 'I've seen three different types of rocker gear on one engine,' says Tisdale. 'Sometimes valves that required caps to protect them from the action of the rockers are mixed with later valves that didn't.

'But more of an issue is the danger of mixing up spark plugs and cylinderhead types. Older cars used plugs with just ½in of thread, while later ones used the more common plug with ¾ in of thread. Put a modern plug into an old cylinderhead and you'll have an extra ¼in of plug protruding into the combustion chamber, ready to punch a hole in the piston when you try to start the engine, and with separate 'heads you need to check every one.'

Any truly unusual and interesting engine is bound to have a few foibles, and when you consider this one's compact size, low weight – partially enabled by Klos's lighter, less stressed internal parts – and good power outputs, it can only be considered a success. An adaptable one too: by 1970 Tatra was using a capacitor discharge electronic ignition system in the 603, making a Forties air-cooled engine look more advanced than the latest designs from Britain and America. Klos and Mackerle's joint achievement was to take a concept as radical as the T87 engine and make it a success in the real world. Ledwinka is rightly regarded as a genius, but he wasn't the only one Tatra employed. CC

Thanks to: *Sam Glover, Ian Tisdale of the Tatra Register UK (www.tatra-register.org.uk), Simon Redrup and Ivan Margolius (www.tatraplan.co.uk)*

BELOW LEFT There are separate fans for the two cylinder banks, each with its own warning mechanism on the dash in case of failure BELOW RIGHT The big blue oil-bath air filter was designed to cope with roads dustier than today's

Julius Mackerle

JULIUS MACKERLE (1909-88) was born into an affluent family living in Moravia, eastern Czechoslovakia, and trained at the Technical University in Brno. Here he built his first car, a JAP-engined two-seater much like those being experimented with by his British contemporaries.

He started his career with Skoda in Plzen, eventually becoming head of the engine department. After World War Two he found himself with Skoda in Prague before moving to Tatra in 1948.

Here, as well as the 603, he designed truck engines and also led the racing programme, developing an extraordinary ejector cooling system for the racing Tatraplan T607s. This featured huge conical exhausts which created a low pressure zone to draw air past the engine once up to speed, removing the need for fans and saving valuable horsepower.

Mackerle went on to become director of engine design at the Czech Institute for Research and Development of Automobiles. He also lectured extensively and wrote authoritative articles and books, including *Air Cooled Automobile Engines*, which is still regarded as a masterpiece and earned him the Herbert Akroyd Stuart Prize from the London-based Institute of Mechanical Engineers.

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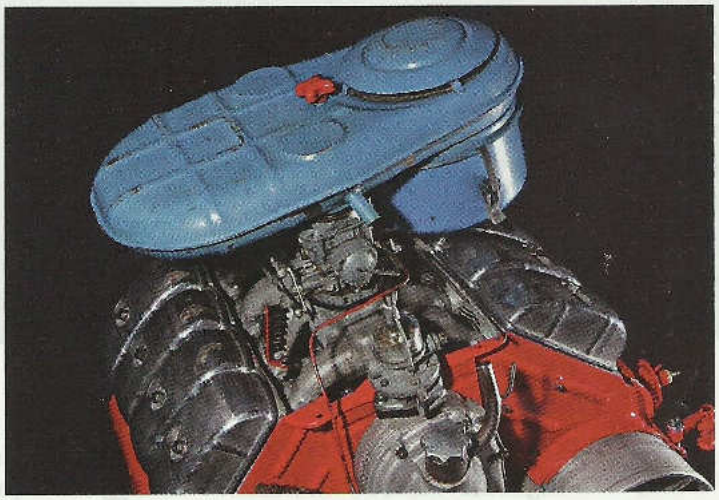

'Put a modern plug into an old cylinderhead and you'll have ¼ in of extra plug ready to punch a hole in the piston'