The World according to: Mike Theaker

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Engine development engineer Mike Theaker helped to develop fuel injection for Minis and devised the current twin-point injection system. He now works in engine development for Rover with John Cooper and on other 'future' projects.

How did you get involved with Mini development?

My first cars were Minis so I had the bug from the start. I went to Sheffield University to study Mechanical Engineering and got a job with Ford when I graduated. After two years I moved to Rover where I have been ever since. One of my first jobs at Rover was development of the Throttle Body Injection (TBI) system for the Mini which was introduced at the beginning of 1991. The Mini was by then mainly a professional interest but I became more enthusiastic again as time went by.

Tell us about the TBI system.

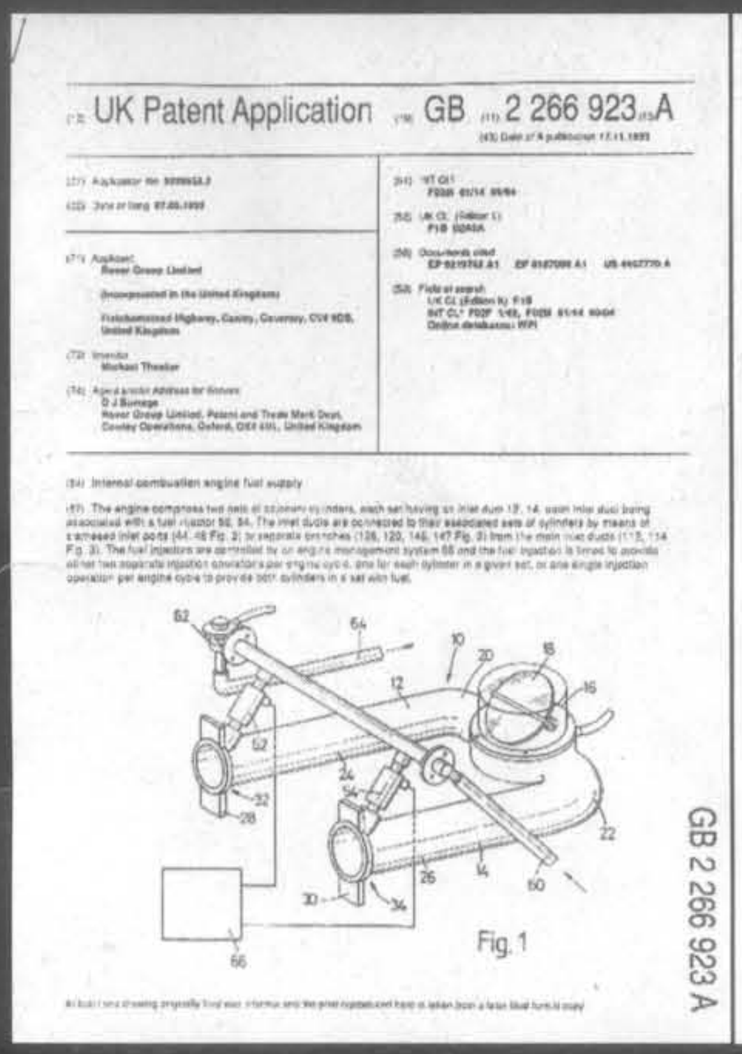
The TBI system was introduced to make the Mini compliant with emissions specification ECD1 and to keep it in production after 1991. The SU carburettor could not meet the new spec and so injection was the only option. The TBI was adapted from the Rover 200/400 system and was essentially a straight replacement of the carburettor by an injector. It had a 'wet manifold' with the fuel being injected at the manifold mouth. There were emissions limitations caused by fuel puddling in the manifold - which we tried to cure by inserting weirs in the manifold tracts.

What was the motivation behind the Multi-Point Injection system?

I felt that there had to be better solution to the emissions and driveability problems of the TBI system and that this would allow the Mini to continue beyond 1996. My initial proposals to build a twin point system were not well received. Some people said it couldn't be done but I was sure it was possible. After many hours of detailed calculations at home, without any authority and against the wishes of some of Rover's senior management, I decided to modify one of the TBI development cars. Working undercover at Gaydon we built a prototype that fired and ran at the first turn of the key and was complete by the end of August 1991. Most of this initial work was done outside working hours, effectively for free. It became a real technical and personal challenge.

"...I did the initial fuelling calculations in pencil on the roof of the prototype car."

Mini's cylinder head only has two inlet ports. Injectors on Mike's MPI system are as close as possible to the ports, avoiding the 'wet manifold' emission problems



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(54) Internal combustion engine fuel supply

(57) The engine comprises two sets of cylinders, each set having an inlet duct (12, 14) upon inlet duct being associated with a fuel injector 56, 58. The inlet ducts are connected to their associated sets of cylinders by means of siamesed inlet ports (44, 46 Fig. 2) by separate branches (126, 120, 146, 147 Fig. 3) from the main inlet ducts (113, 114 Fig. 3). The fuel injectors are controlled by an engine management system 66 and the fuel injection is timed to provide either two separate injection operations per engine cycle, one for each cylinder in a given set, or one single injection operation per engine cycle to provide both cylinders in a set with fuel.

Fig. 1

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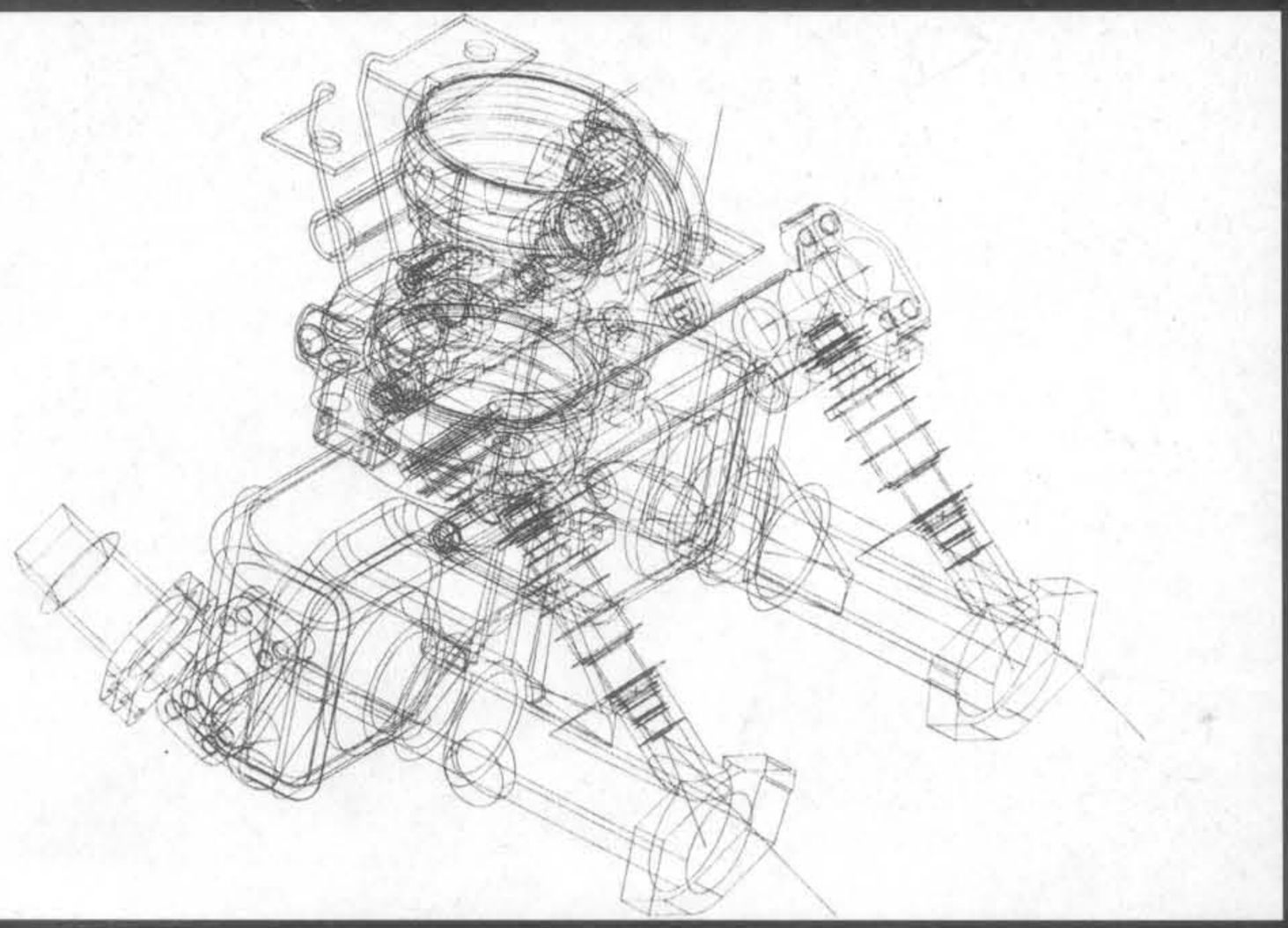


What were the problems you had to overcome?

The Mini MPI [Multi-Point Injection] system is one of the most complicated ever devised. The essential problem is that the Mini's cylinder head has 'siamesed' inlet ports. That is one inlet port feeds two cylinders - which need fuel pulses at different times in the engine's cycle. In between working on the Mini TBI system and the MPI system I had worked on the MGF VVC engine and was able to adapt some of the thinking behind the MG system to the Mini application. The final version of the MPI system is extremely close to the original prototype. We arranged that fuel was injected as close to the head as possible to keep the wetted area of the manifold to the minimum (this improves emissions). To cope with different speed, load and temperature conditions we had to fire two pulses of fuel, back to back, into the inlet port. This double pulse grew both backwards and forwards depending on engine conditions. This enabled us to inject the correct amount of fuel for all situations. This was an entirely new principle which we named 'bi-directional pulsewidth stretching.' The software for the MPI system is extremely complex but I did the initial fuelling calculations in pencil on the roof of the prototype car. On the prototype we had no camshaft sensor so the car would only start 50% of the time. This was rectified for production cars.

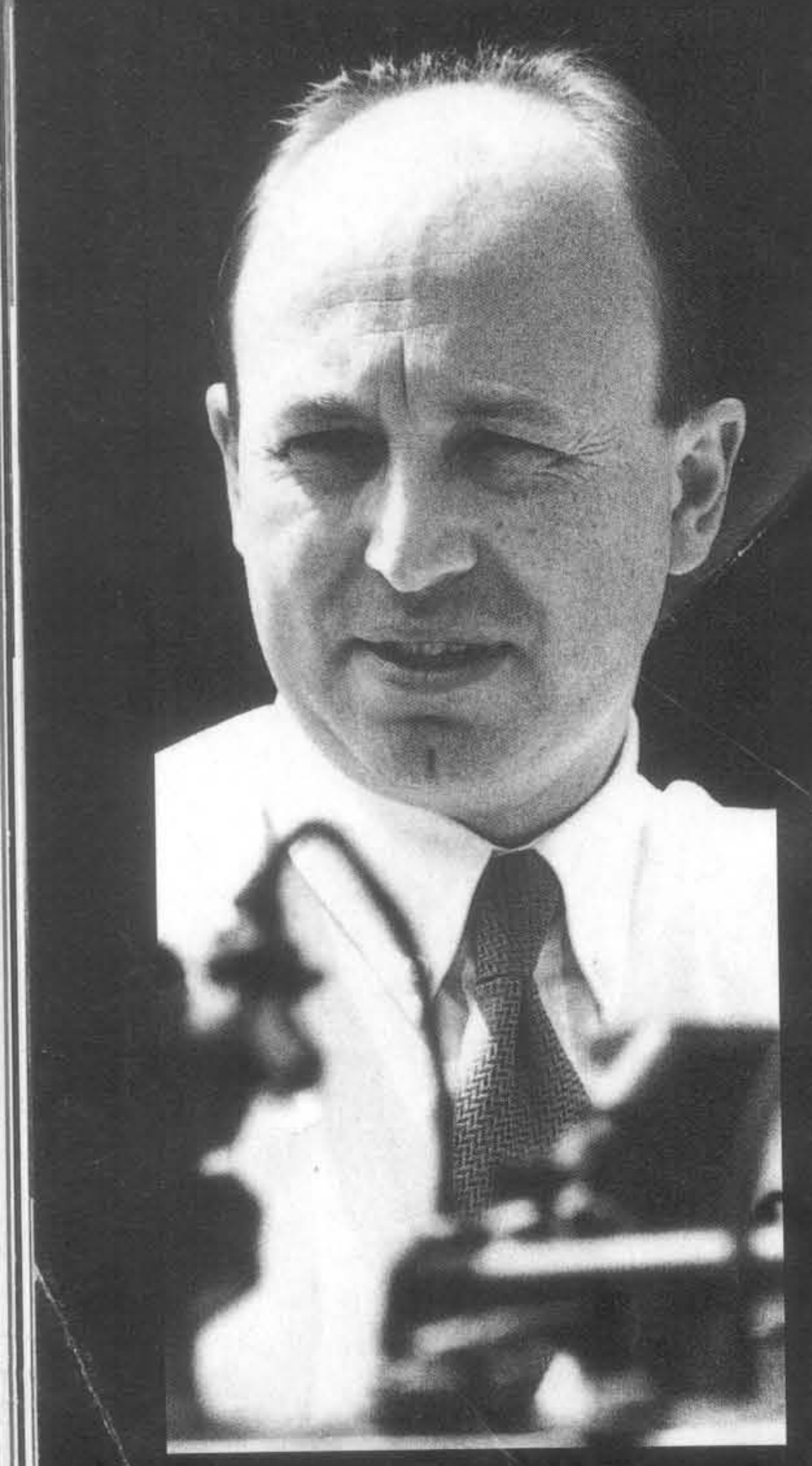
What are the advantages of the MPI system over the TBI system?

Essentially improved fuel economy, throttle response, driveability and emissions. The fuel distribution between cylinders and control of the fuel is better than the TBI system and there is also the advantage of the reduction in wetted area inside the inlet manifold which, again, helps reduce emissions.

How did Rover respond to your work?

I revealed the prototype to my Chief Engineer in 1991. He was suitably impressed and a patent was applied for by Rover in my name during 1992 and was granted in 1995. There were problems with the prototype but the potential was clear. Nothing really happened on the MPI until 1994 when BMW took over. John Cooper had driven an early

prototype and, at the Motor Show that year, he asked Rover's Engineering Director, Silvert Hiljemark, why we weren't going ahead with development. Mini would have had to cease production at the end of 1996, due to non-compliance with the ECD2 regulations, but BMW were now keen to keep it going until 2000 when the new Mini was scheduled to start production. The combination of BMW's will and John Cooper's insistence meant that the climate was right and 'productionisation' of the system took place. The MPI system was introduced into production cars in 1996.



The public responded to the MPI system as an incremental change rather than a revolution, was that fair?

Significantly it extended the production life of the Mini by four years. However, the MPI system was introduced along with several other major changes to the car, which blunted its impact. The Mini's final drive ratio was raised from 3.2:1 to 2.7:1 at the same time, which was intended to reduce drive-by noise, but it didn't help throttle response and acceleration. The fact that we were getting more torque from the engine therefore went unnoticed. Fuel efficiency was increased but then the addition of wide tyres and their attendant wheel arches did nothing for the overall fuel economy. Our prototypes were fitted with a 3.2:1 final drive and narrow tyres and they went like a bomb.

The Injection manifolds have been criticised for being crude. How would you respond to that?

It is fair to say that the MPI manifold is not as I first conceived it. It works as well as it can within the limits of a mass-produced item. Improvements could always be made but remember that any modification to the engine means re-calibration of the fuel metering system - which is far from simple.

Have you contributed to the Mini's development since then?

I still have a brief to assist with John and Mike Cooper's engine developments. I make sure that they are safe from Rover's point of view as Rover warranty applies to some of the Cooper S engine conversions. I also work with John and Mike on any specials including Mike's own personal car recently featured in MiniWorld. The Coopers have become good friends, they're a great inspiration. I speak to them at least three times a week.

Weren't you involved with the ACV30 concept car?

Yes. In early 1997 we took the ACV30 to the Monte Carlo Rally. It was based on an MGF and used a 1.8-litre K-series engine. I had to provide engineering support for the car as it ran on a special stage around the GP circuit in Monaco. We also took the three original Monte-winning Minis which were driven by their original drivers Hopkirk, Makinen and Aaltonen. It was a great experience and generated a tremendous amount of interest in the new Mini. It also gave me a chance to drive 33 EJB at the Monte Carlo Rally.

You have a Mini of your own, tell us about that.

It is one of my own ex-development car and carries the S Works prototype no 1 chassis plate. It's effectively the first Mk5 Cooper S Works. It was used for trim development, developing the S Works kit and as a benchmark car for the new Mini. I enjoy it, it puts out a safe and reliable 90bhp at 6000 rpm and is great fun to drive.

What are you working on currently.

I am currently Engine Calibration Manager for BMW/Rover but I will soon be moving to Ricardo Consulting Engineers to continue work on powertrain development for new Mini. Obviously I can't tell you anything about that other than it's going to be a fantastic car with all the best features of the Classic Mini.