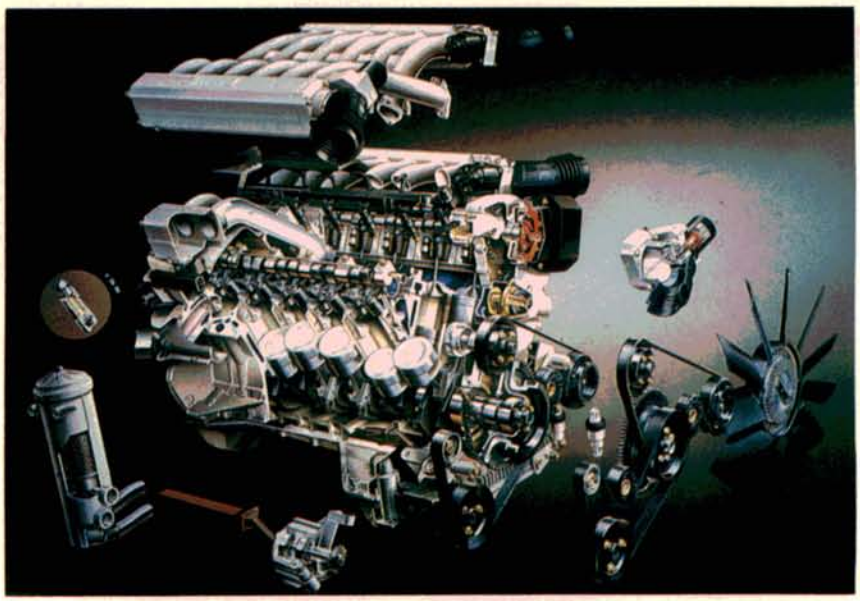


BMW V12

Most of us have never even seen a V12 engine, let alone worked on one. Admittedly, the likelihood of having one of these pull up to your shop is slim indeed. The new V12 from the BMW is worth looking at, however. First, it includes some new technology that may find its way into other cars. Secondly, it lets us look at the physical characteristics of a V12 engine that make it so smooth.

Compare it, for instance, to that four-cylinder engine that powers the average econo-box. The four cylinder fires two cylinders for each 360 degree rotation of the crankshaft. That means an explosion every 180 degrees of crank rotation. Two pistons are at TDC and two are at bottom dead center at each firing. Unlike a straight-six engine, for example, we don't have any pistons at "half mast" at this point to help absorb vibration.

Now look at this V12 which fires off a cylinder every 60 degrees of crank rotation, or six firings per complete revolution. This lessens the impact per piston compared to total displacement. Also, since there are 11 other pistons at different stages of "up" and "down," even more vibration is absorbed.

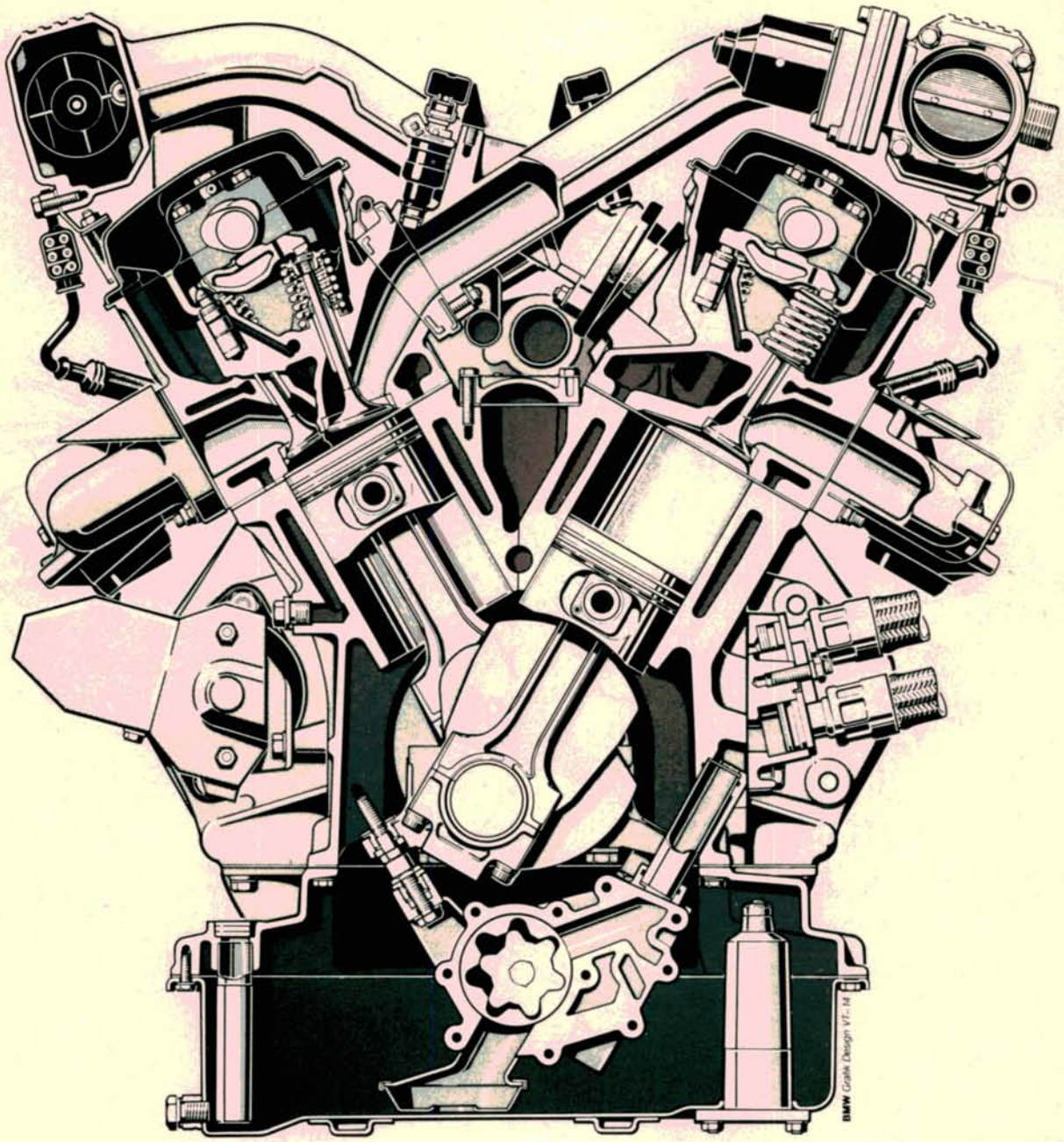
Since individual pistons are smaller than those in an engine having the same displacement but fewer pistons, the amount of weight being thrown around at the end of that connecting rod is also smaller.

You might want to think of it in terms of the force generated by a spring rain, as opposed to the more concentrated force of a garden hose, water volume being equal. Vibrations, like the drops of rain, are spread over a greater area. There are a greater number of impacts from the drops of rain, but each has less force than the stream from the hose.

OTHER REFINEMENTS

Other refinements on this V12 include:

- Chain-driven dual overhead camshafts and hydraulic lifters open two valves per cylinder. The chain runs in guide rails and is adjusted hydraulically by an oil-fed tensioner.
- Drive belts for the accessories are automatically adjusted by hydraulic tensioners. Also, a lock sensor is used to make the air conditioning clutch free-wheel if the compressor would ever seize. This insures that the water pump and fan keep turning to cool the engine.
- Equal length intake runners mount on elastic sealing plates to absorb vibration. Injectors mount in the flanges on the runners.
- The area between the cylinder heads is soundproofed.
- Oil pressure is provided by a two-stage rotary pump. Part of the pump sucks oil through a snorkle and feeds a high pressure outlet pump. This two-stage approach



helps insure a constant supply of high pressure lubrication to all critical parts.

• The cylinder head covers and oil pan sump are made of a laminated metal-to-fiber-to-metal material to deaden sound.

• Although the crankcase is aluminum, certain precautions have been taken to stiffen and reinforce it. This is done both by the design of the crankcase, and by the manufacturing process when it's cast.

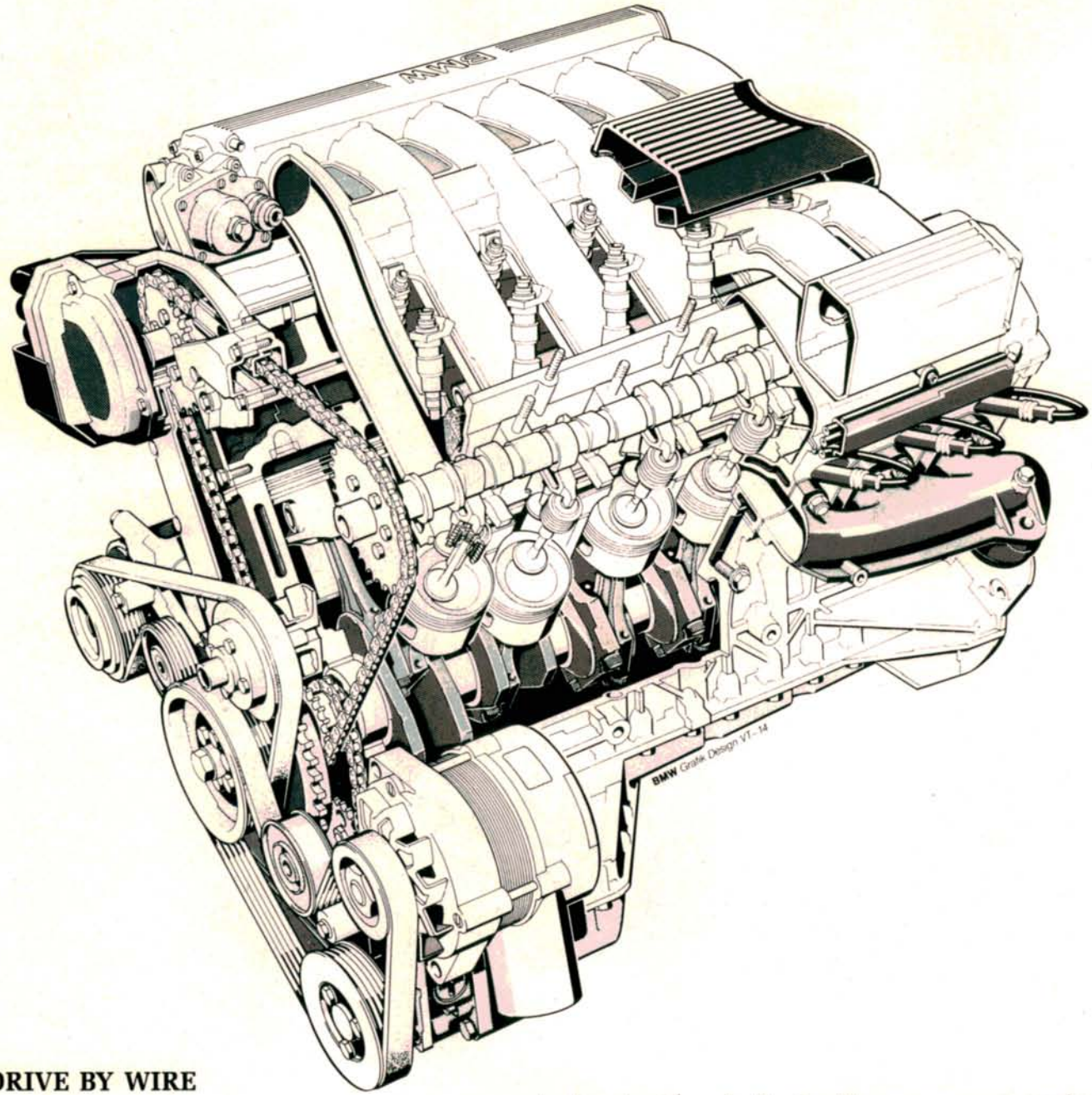
The following precautions have been used to further reduce vibration:

• The forged crank turns in seven main bearings (12 counterweights) using closer-than-average bearing tolerances. The bearing caps are cast iron and have four bolts per cap. Two bolts are installed vertically; two more screw in 30 degrees from the vertical line of the engine, parallel to the cylinder bores.

• Pistons are steel-jacketed aluminum which reduces piston mass and vibration.

• The engine oil pan is also designed to act as a structural reinforcement. It is made in two sections and has reinforcing ribs to help reduce crankcase flexing.

• Individual hot wire air flow sensors control the fuel to the two banks. Actually, there are two complete six-cylinder fuel systems known as DME 1.2 Engine Management Systems. There are also two separate secondary ignition systems; two ignition coils, two crank angle sensors, two distributors, and so on. These are monitored and synchronized by the EML or Electrical Motor Load Regulation.



DRIVE BY WIRE

The EML system is a true drive-by-wire system. There is no mechanical connection between your foot and the throttle—no cable—no linkages.

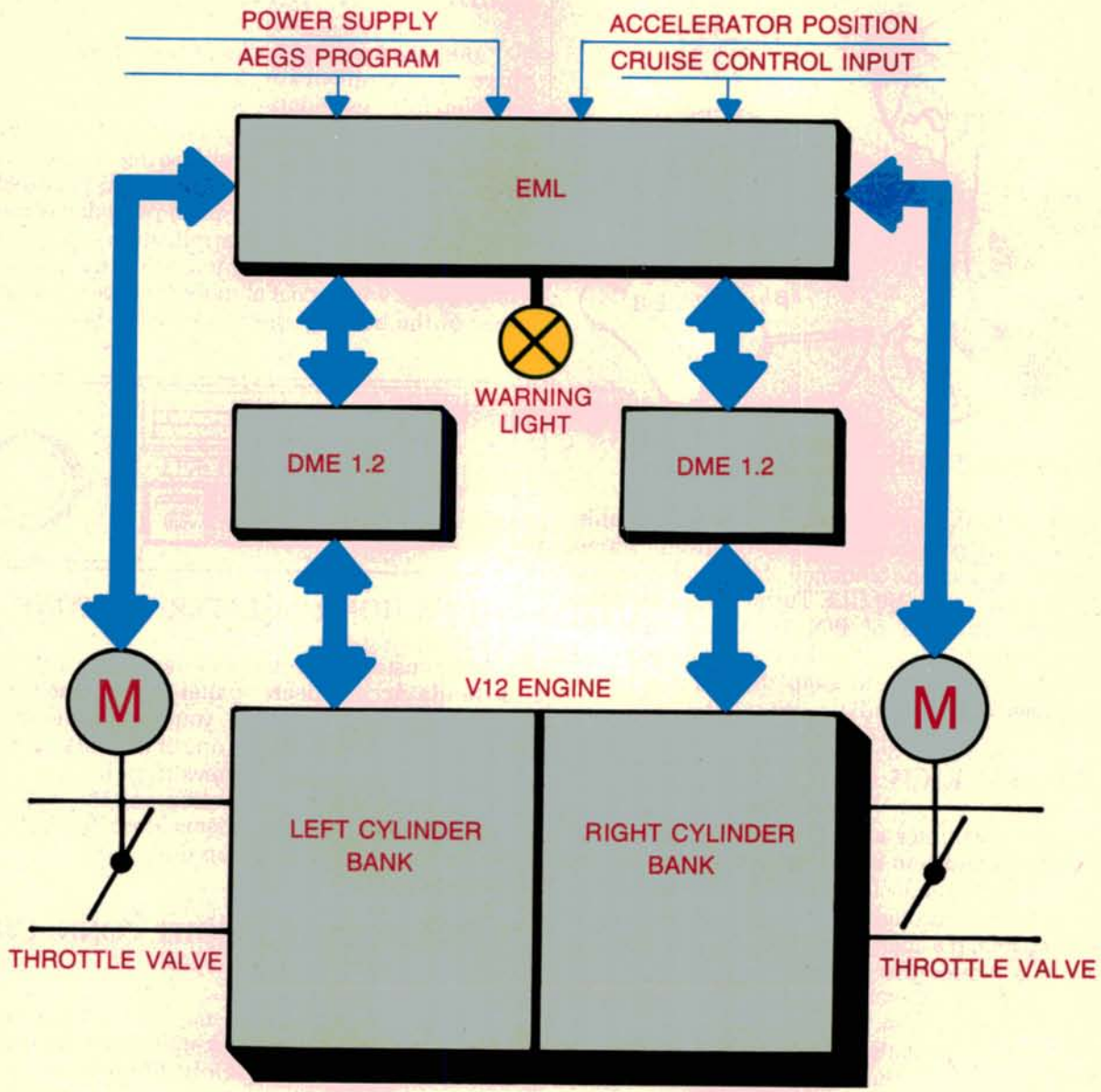
A potentiometer and a set of switches are connected to the accelerator pedal. They send analog voltage signals to the EML computer telling it how far down the pedal has been pushed.

As the driver presses on the accelerator pedal, the computer gets messages about the driver's desire to speed up or slow down.

Each throttle valve is hooked to a small gear-driven motor. The computer activates these motors to open or close the throttle valves. Throttle position sensors send messages back to the EML, comparing information about how far the throttles are open compared to the messages sent by the accelerator pedal.

In addition to simple acceleration and deceleration control, the EML controls other special needs.

- Synchronization of the two cylinder banks.
- Idle speed control (including fluctuations caused by air conditioning loads).
- Cruise control operation.
- Engine over-rev protection.
- Limits on vehicle top speed.
- Proper positioning of the throttle for start-ups.
- Idle speed correction during warm ups.
- Synchronization of engine and transmission operation.
- Fail-safe programs.



FAIL SAFE

The EML system has a number of fail-safe features built in, and many of the self-checks done by the computer actually overlap. The computer is programmed to look for outright failures. Even more importantly, it's on the lookout for any signals that either contradict one another, or just don't make sense.

For example, let's say the computer gets a steady message that the throttle is partially open as it would be when cruising on a flat, open road. But what if the constantly open throttle means something is stuck open? If the driver hits the brakes but the message about the open throttle is still sent to the computer, the computer says "whoa."

The computer knows that even though it hasn't necessarily received a fault code from an individual component, this situation just doesn't make sense. The throttle and brakes should not be applied in this particular combination.

EML now overrides normal fuel system operation to correct engine RPM. If there is a fault code, the computer will evaluate that code and take whatever action it feels is necessary to reduce engine power. It may close the throttle, or if the throttle really is stuck, it will shut down the injectors.

At this point, a warning lamp comes on to warn the driver that something is wrong. Even the warning system has a back-up, using two bulbs in case one burns out, to insure that the driver is properly alerted in the event of a failure!

—By Ralph Birnbaum