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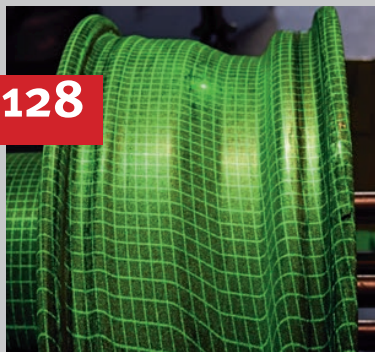
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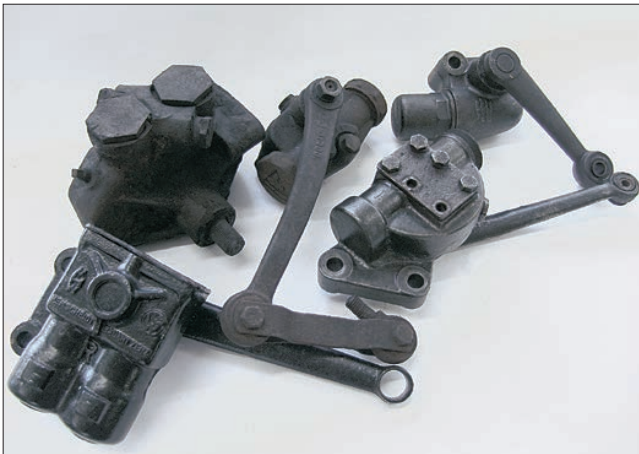


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A broad topic: lever-type shock absorbers exist in a wide variety of models.

Without the calming effect of its shock absorbers, a car's suspension would constantly dance a jig – with dangerous consequences for the car's roadholding and handling! In this and the following chapter we take a closer look at three popular models of shock absorber: the friction, lever and telescopic types.

Left to its own devices, a car's steel suspension would simply jump up in the air when going over every pothole. This is where shock absorbers come in, which have helped settle cars' suspension for nearly 100 years.

A shock absorber is really a vibration damper. It absorbs part of the energy which occurs alternately as spring tension or as movement of the car's bodywork. The energy which is removed from the car as it vibrates is converted by the

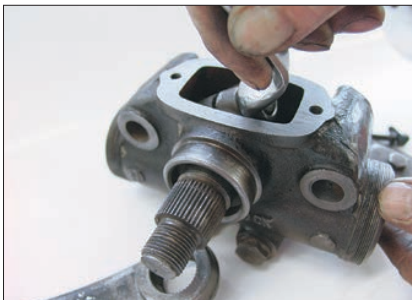
shock absorbers into heat. Well-adjusted shock absorbers do this in such a way that, on the one hand, a considerable degree of suspension travel is used, and few shocks are transmitted to the car's body; and, on the other hand, the body does not go on vibrating after a single compression and rebound cycle.

When motoring was in its infancy, the damping required was provided by the intrinsic damping of the leaf springs themselves, with their leaves rubbing against each other. With the breakthrough of pneumatic tyres and increasing speeds, however, the damping provided by the springs was no longer sufficient.

This was when the scissor-type friction shock absorber came into being. In this design, one of the 'blades' of the scissors is connected to the chassis frame or body, the other to the axle or wheel carrier. Where the blades pivot, there are spring-loaded friction plates made from metal, wood, leather or other materials, as were also used for clutch and brake linings. Between them the kinetic energy of the car's bodywork is, to a certain extent, dissipated as heat.

From the early 1930s or thereabouts, hydraulic lever-type shock absorbers gradually replaced the friction-type shock absorbers which had been popular until then. The latter survived for a few more years in the world of motorsport, as they could be quickly and easily adjusted, while lever-type shock absorbers became dominant for mass-produced cars, and were only seen off in the 1950s and 1960s by the telescopic shock absorbers which remain current today.

The operating principle of the hydraulic shock absorbers still in use is always the same, regardless of their exact configuration: the vibrational energy acts on a piston



A job for specialists: the outer lever has already been pulled out. After releasing ...



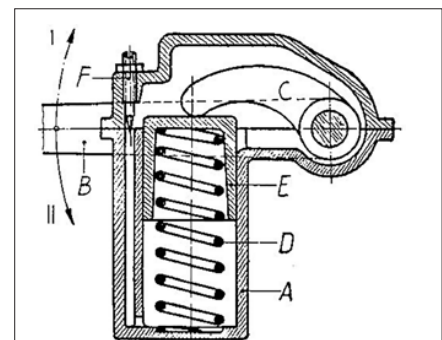
... the screw, a puller can now be used to extract the rod and remove the piston lever.



Control valves: after the sealing caps have been taken apart, the valves ...



... can only be unscrewed with a special tool (which can, however, be easily fabricated).



Single-direction shock absorber

A Housing

B Rocker arm

C Lever

D Spring

E Piston

F Adjustment screw

I Movement during compression

II During rebound

Mono-type lever shock absorber: only the extension or 'rebound' stage is hydraulically damped.

If your car has failed a vibration test, like that in the German TÜV safety inspection, then there's work to be done. The vibration test rig is merciless in showing up the smallest defect in a car's steering or suspension. It can help identify faults which often go undetected by an amateur mechanic. Even the early stages of wear can be uncovered, which is all to the good, as there are few parts of the car where the individual components need to work together so closely as in its suspension. Damage to one component will quickly trigger another fault elsewhere. If the ball joints have had it, the increase in the force applied when steering will mean that the tie rod ends will not last much longer either. Misaligned tie



Without a repair manual you won't get far, as you always need the alignment settings.

rods will, in turn, result in uneven tyre wear. If the kingpins are faulty, the whole wheel will start to wobble.

The inspection keeps your car safe, prevents more problems in the future, and ultimately contributes to your pleasure behind the wheel!

The vibration tests essentially check three sets of components: the ball joints; the suspension bushes; and, on older models, the kingpins. We'll explain the job these different components have to perform, and what can go wrong with them, before embarking on our workshop tour.

The earliest designs of car suspension used a solid front axle. The wheel, complete with the steering knuckle, was held in place with a bolt with a brass bearing. After



A typical example: the TR6 has two wishbones on each side.



Dismantling starts with the anti-roll bar attachment.



A puller is used to pry off the tie rod ends.



In the past, so-called 'pickle forks' were used, but they weren't great so close to the rubber gaiters.



The lower retaining bolt can be withdrawn safely.



The shock absorber is still retaining the spring. Next, the steering knuckle can be folded out of the way.



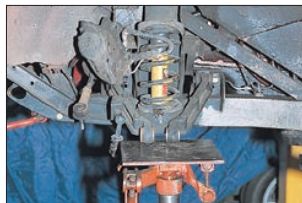
The upper wishbone is not held under tension.



The steering knuckle can now be removed, together with the wishbone.



Further disassembly can be carried out comfortably on the workbench.



Take care: the load must now be taken off the shock absorber, so that ...



... the upper mounting bolt can be undone without danger.



Once the bottom bracket has been dismantled, the shock absorber ...



... can be withdrawn. Now the bottom wishbone, together with ...



... the camber adjustment plates, can be removed with the help of a spring compressor.



On the workbench: the lower wishbone link needs to come out.



Then the bracket on the upper wishbone can be undone.

Eventually, even the strongest drivers found unassisted steering too much: as cars became heavier, so too did the effort required to steer them. Help was at hand in the United States, though, in the form of power-assisted steering.

In 1921, Harry Vickers invented the vane-type pump, paving the way for the first power-assisted steering. The system used a pressure of at least 950psi, and was driven by a V-belt. It was another four years before the first passenger car – an Oldsmobile – was equipped with power steering, driven by a Vickers vane-type pump.

The basic design of this early power steering system is more or less the same as that of the ATE system (illustrated here), which was offered on German cars in the 1960s. This hydraulic system comprises a pump, a control cylinder mounted on the steering column, and a working cylinder installed parallel to the tie rod. Depending on the steering direction, the control cylinder directs the pressure to one side or other of the working cylinder, which then provides assistance in steering the wheels. Even if the system fails, the mechanical linkage between all the components is maintained. When the steering is at rest or at the end of a steering movement, the pressurised fluid flows via the return line to the reservoir, and then back to the pump.

The hydraulic power steering on the Mercedes W108, W110 and W111 series covered in this chapter is very similar. In this case, however, the hydraulic pressure acts directly on two working pistons inside the steering mechanism. The system is regulated by a so-called ‘control rail,’ which engages with the groove in the control piston. This directs the pressure to the respective working piston. At the time the pump was manufactured by Vickers Germany, a company which later merged into the vehicle hydraulics division of the LuK group. The housing for the steering mechanism was produced by Georg Fischer (GF) on behalf of Mercedes-Benz. As well as Vickers, ZF in Friedrichshafen also offered hydraulic pumps. General Motors mainly installed American Saginaw pumps, whereas English cars mainly used roller-type pumps made by Hobourn. The latter used rollers in place of vanes, and are, therefore, somewhat less efficient, but are otherwise similar in construction.

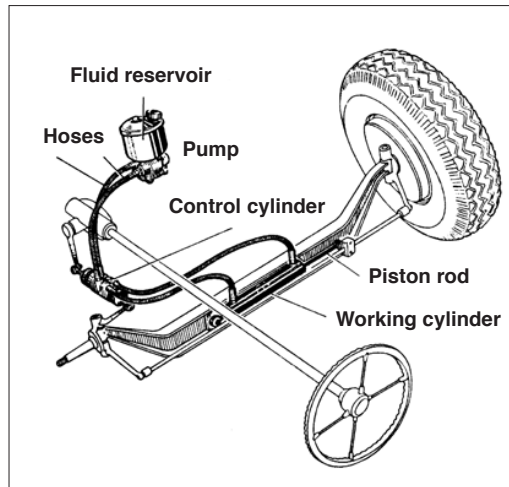
Leaks are common in power steering systems, and can lead to reduced effectiveness or complete failure of the system. The other components of a power steering system are broadly similar to those of a mechanical set-up, repairs to which we have already described.

Even if repairs are mainly a matter of replacing seals, sealing rings and O-rings, the steering system is important for the safety of your car, so only experienced mechanics should attempt to work on it. Of course, you can save some money by doing the job yourself, but, if in doubt, you should always turn to a professional!

Let’s begin with the hydraulic pump. Problems with the pump will usually result in the steering feeling heavy. Before examining the pump, though, first check and, if necessary, top up the fluid level in the circuit, in accordance with the owner’s manual. In addition, make sure that the belt pulley is securely located, and that the belt is correctly tensioned. Some systems have a

gib which prevents the pulley from slipping on the shaft, but this can sometimes break. Inside the fluid reservoir is a filter, which should be changed every 50,000-60,000 miles (80,000-100,000km). Home mechanics often neglect this when servicing their cars, with the result that blockages are not uncommon. The gasket under the cover (often paper on older cars), may also be damaged. If none of these faults can be seen, and fluid isn’t leaking from the pump housing or the steering hoses, it’s likely the so-called ‘rotational group’ has suffered damage.

This group consists of the rotor (with slits cut into it, and vanes which expel the fluid through centrifugal force), the contour ring (which somewhat resembles the trochoidal rotor housing of a Wankel engine), and the two side plates. If signs of wear or grooves can be seen on any of these, the only solution is to replace the entire unit, which will cost ●x350 (the parts are no longer officially available from Mercedes-Benz). A two-part seal kit is also available costing about ●x220. By comparison, a new pump from Mercedes costs ●x890! If you have an old part to exchange, you can save about ●x130. It is well worth contacting the



ATE power-assisted steering.



The shape of the contour ring in the rotational group is reminiscent of a Wankel engine. The centrifugal force pushes the rotor vanes to the outer edges and the fluid flows under pressure through the side plates.



The filter in the fluid reservoir provides protection against dirt.

What should you do when the wheels on your car start to wobble? Repairing light-alloy wheels is a tricky subject. And not just technically, but legally, too: vehicle licensing regulations allow little leeway. We will show you what can be done, and what the vehicle examiners will accept ...

If potholes, kerbstones or mistakes when driving have ruined your fine alloy wheels, salvation is at hand, while staying legal – at least in the majority of cases.

One thing is clear: the word ‘rim’ strictly refers only to the outer section of the wheel, to which the tyre is fitted. This term dates back to the time when wheels were still made from several parts. For a long time, it was used even for one-piece wheel carriers with a solidly welded central section. We will stick to the generally accepted use of the

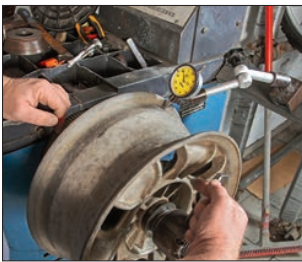
term, even though multi-piece light-alloy wheels continue to be produced.

Light-alloy wheels reduce the unsprung weight of the car, which is beneficial not only in motorsport, but in everyday driving, when the lightweight wheels will make big, heavy saloons more comfortable to drive. And let’s not beat around the bush, they certainly look better than steel wheels ...

The development of metal alloys and the production of aluminium and magnesium-alloy wheels has been refined over the years. Three-quarters of all the alloy wheels produced before 1980 or so would not pass the quality checks carried out by pretty much any manufacturer today: blowholes and other casting defects, or wheels which ran slightly out-of-true, were commonplace when alloys were new.



Light-alloy wheels first became fashionable as accessories in the 1960s. Soon, car manufacturers also offered them. The E3 (left) was available to order from BMW with BBS wheels. The Ronal wheels on the Glas O4 (right) were sold on the aftermarket.



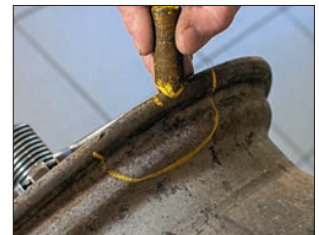
To start with, the wheels are examined visually and to check that they run true.



On the inside of the rim, the specialist determines and marks the highest point of the imbalance.



The rim flange is also checked. Any small chips here can lead over time to the development of cracks.



An impact from a kerbstone, with slight distortion around it.



The final doubts are dispelled: the laser measurement reveals any impacts to the top or side of the rim.



The inspection sheet provides a good deal of information: here it shows the presence of impacts to the top and side of the rim. The bead seat, on the other hand, is unremarkable.



These wheels have had it: the fracture (on the left) has occurred as the result of attempts to repair the wheel. In the photograph in the middle, the distortion has gone too far down into the rim well; on the right, the damaged area is too large.