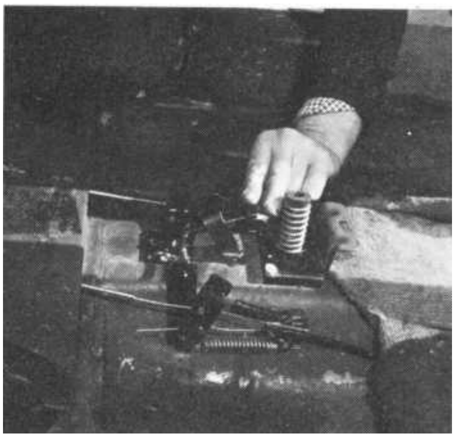
Self-levelling headlamps

by David Scott

A simplified system in prototype form

Pat Martin's Morris 1100 has self-levelling lamps in the normal positions, fixed sealed-beams for comparative tests.



Compound levers under the front seat integrate the weight on the cushion with the load in the boot, and signal the sum to the tilting headlamps.

A simple self-levelling system for headlamps has been evolved by Pat Martin, a motor trader of Bromley, Kent. It holds the beams on the road regardless of the weight in the boot or the number of back-seat passengers and it also controls the aim of the lamps under braking nose-dive or acceleration lift. Citroen, of course, have had self-levelling lamps integrated with their complex, hydro-pneumatic suspension for some years, but this is a low-cost system that could put this important anti-dazzle and safety feature on the humblest machine.

Pat Martin is also the inventor of the Rotadipper steerable headlamps now sold in kit form and he estimates that this rig would cost only a pound or two as a factory installation. His scheme is merely to measure the actual load in the boot and on the rear seat with spring scales, and tilt the lamps down to correct for body squat. This is far simpler and cheaper than using sophisticated sensors that detect body height relative to the suspension, when individual signals from the four wheels are needed to determine the true attitude of the body on the road.

It's all done with an ingenious concoction of levers, springs, piano wire and pendulums. The boot deck is pivoted at the rear and floats at the front on a pair of stiff coil springs, with foam plastic blocks under each front corner to keep it level.

Underneath is a bell-crank lever with a roller on its longer arm that bears against the deck. There are two parallel shorter arms linked by piano wires to a pair of compound levers beneath the rear seat on each side of the central tunnel. Each of these tandemed levers is also a bellcrank and responds to the height of the seat cushion, which is again pivoted at the rear and sprung in front. They operate the individual wires that separately angle the headlamps.

These levers can both add and subtract. They integrate the two variables-the boot and seat weights-and produce the sum. Each is a lever fulcrumed on another lever. Pivoted at the base of the bellcrank on the tunnel is a secondary arm to which the boot-wire is tied. The wire running forward to the lights is connected just above the lower pivot.

Thus the movement of the headlamp-wire is controlled by both boot and seat bell-cranks, but independently, with a differential action. This is because the boot-wire attachment point on the compound lever is close to the main pivot on top, so any movement of the seat lever has little effect on the height-signal from the boot lever. Similarly, the headlamp-wire is low down close to the secondary pivot, so movement of the boot lever doesn't distort the message from the seat lever.

Springs do key jobs all along the line. Two pairs of light ones pre-load the compound lever so the two bell-cranks are held firmly against the boot deck and seat cushion. Coils supporting the deck and cushion are calibrated for just the right compression under progressive loading. Front corners of the cushion are steadied by additional coils combined with dashpot plungers that act as shock absorbers, so the seat movement responds only to static weight, not to transient bumps on the road or the sudden thump of an entering passenger. These dampers prevent unwanted flicking of the lamps.

The real crafty stuff is in the headlamp units themselves. For each one the tilting linkage operates through a pendulum that swings the beam down when you accelerate, up when you brake. That's for dynamic correction. The 2.5lb. suspended weight, which is the only link with the lamp, is hung from a longitudinal slide. The piano-wire signal from the rear of the car positions the slide horizontally, and this travel is passed to the lamp from the top of the pendulum.

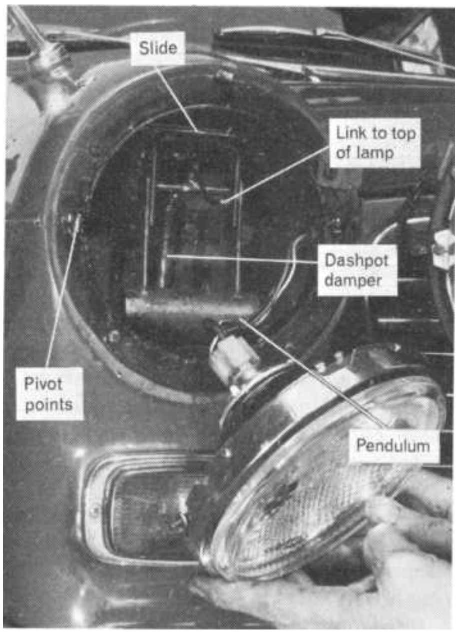
Thus the pendulum is a variable reference point for the whole self-levelling system. The load in the car fixes its fore and aft position for static control of the beam. And from this location it responds to inertia for dynamic control. The pendulum is also affected by gravity to tilt the lamp on hills. When you're climbing the beam dips, compensating for the tail-end sag caused by the rearward shift of the car's centre of gravity. In the same way the beam rises on a descent, so at all times the light keeps its normal aim on the road.

A dashpot coupled to the pendulum prevents its oscillation or over-correction. It permits only smooth and gradual swings and angling of the lamp, which can tilt as much as 4 degrees above and below the centre line.

Martin claims an accuracy of one-tenth of a degree, far higher than with any other system. He demonstrates this on a graduated chart in his garage. Horizontal lines spaced 3 in. apart each represent one degree of elevation of the headlamps from a distance of 15 ft.

First he dumps four 50-lb. sandbags in the boot of his car, which is a Morris 1100 experimentally fitted with a pair of fixed as well as self-levelling lamps. The fixed lamps are on, and rise 14 degrees on the chart-enough to blind an approaching driver. Then he switches to the self-levellers and their beams are dead on the centre line.

Now three men pile into the back seat. The fixed beams lift to 2.5 degrees, but the others are still dead on centre. For a final test Martin backs up the car, then races forward to the 15-ft. mark for a crash stop. On this violent braking the body dips low at the front yet, once again, the lights stay right on the mark. **M**



Above: the mechanism hidden behind the reflector and, below, the layout in schematic form.