Words and pictures –
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Switch gear

An overdrive unit, as fitted to many MGBs, provides a useful and fun extra gear ratio. We show you how to ensure your car's overdrive is reliable and effective

Overdrives are often let down by the electrical and hydraulic systems that control them. And although many faults are easily cured, their diagnosis requires a thorough understanding of the principles involved.

Overdrive provides higher ratio gearing which allows lower engine revs for a given road speed, promoting better fuel consumption and lower noise levels. The high torque normally generated in first and second gears would over-stress the unit, so an inhibitor (or gearbox switch), indirectly activated by the gearlever, prevents engagement in low gears. It also prevents engagement in reverse gear for reasons explained later. The overdrive ratio of 0.8:1 or 0.82:1, depending on the type, equates to around an extra 4mph per 1000rpm in top gear. It effectively provides a six-speed transmission with the overdrive/third gear ratio sitting usefully between direct third and direct top. Although prominent on the MGB, initially as an option and later as standard (on right-hand-drive cars from 1976), other MG models can be converted to overdrive.

The Laycock-de Normanville overdrive appeared in several forms. The MGB used a D-type up to commission numbers prefixed 18GB, and an LH-type thereafter. The changeover date is nominally 1969. The LH-type is recognised by its large rectangular sump plate, although the manufacturer's plate states the type on both.

How it works

The mechanics

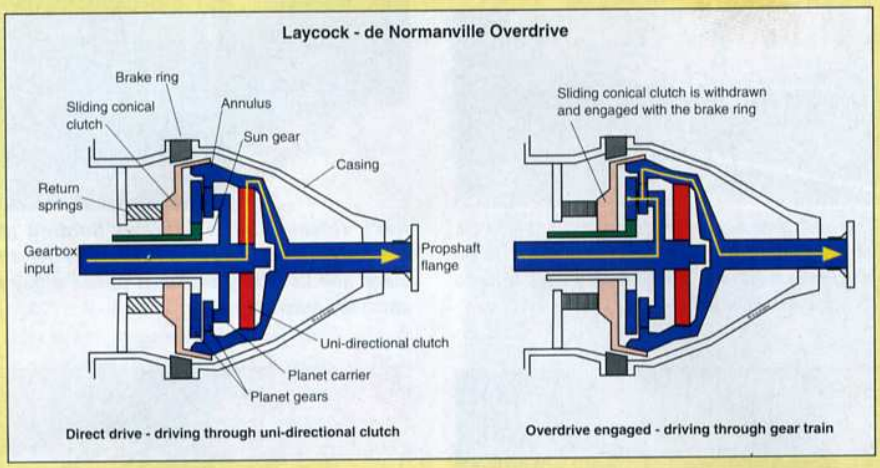
Mechanically, the overdrive is an extra gear train tagged on the back of the gearbox, but the gears are in a circular arrangement revolving around each other, unlike the gearbox's side-by-side layout. The compact epicylic arrangement suits the restricted space between the gearbox and propshaft. The diagrams shown above, which are not to scale, illustrate the principle of operation.

The gearbox shaft extends into the overdrive casing with the central sun gear rotating around it. Three pairs of planet gears revolve around the sun gear, supported on a carrier fixed to the input shaft. A cylindrical annulus gear, attached to the overdrive's output shaft, encloses the sun and planets, its internal teeth meshing with the planet gears. The annulus is linked to the input shaft through a uni-directional clutch which allows one-way drive.

A conical clutch (also known as a sliding member) is splined to the extended hollow shaft of the sun gear, rotating with the sun but able to slide along the splines to engage or disengage the overdrive gearing.

The clutch has a friction face on its inner and outer edges. In direct drive, coil springs hold the clutch against the annulus, locking the entire gear train with the output shaft. In theory, the drive could be transmitted through the locked gears but this would place stress on the teeth, so drive is directed from the input shaft through the unidirectional clutch to the output shaft. During overrun, the unidirectional clutch freewheels.

When overdrive is selected, the conical clutch moves away from the annulus and locks against the brake ring which, in turn, locks the sun gear. The input shaft (via the planet carrier) then drives the large planet gears around the fixed sun. The small planets are revolving too, turning the annulus at a higher speed than the input shaft, creating the increased gearing.



The hydraulics

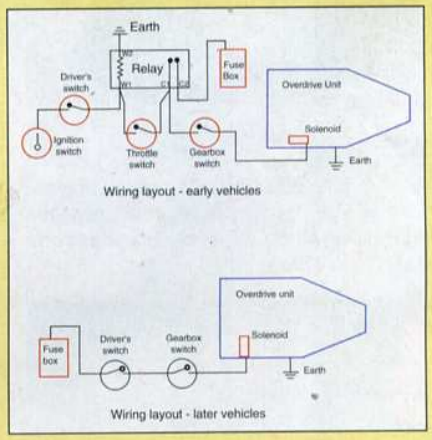
The conical clutch is moved by two hydraulic pistons pressurised by a plunger pump driven by a cam on the input shaft. Oil is delivered via a non-return valve and relief valve to the operating valve which controls flow to the pistons. Excess oil is bled away to lubricate the bearings, gears and uni-directional clutch. A sump filter and magnetic pads or washers keep the delivered oil clean.

When overdrive is switched in, the operating valve is opened by the solenoid (via a lever on the D-type, or direct action on the LH-type). When switched out, the solenoid retracts, allowing the operating valve to close under spring pressure. Oil in the operating pistons is de-pressurised, allowing the coil springs to move the conical clutch back to the annulus, locking the gears.

The electrics

The solenoid is a simple on/off device controlled from the driver's switch. On LH-types, power is taken from the fuse unit via the driver's switch, then through the gearbox switch to the solenoid which is earthed to the overdrive casing to complete the circuit.

The D-type has a more complex system incorporating a relay and a vacuum-operated throttle switch which provides an interlocking safeguard against disengaging the overdrive while the throttle is closed. Under acceleration or light load the overdrive will disengage normally. But, if the overdrive is switched out while the accelerator is backed off (maximum engine manifold vacuum), the vacuum throttle switch will stay on, maintaining an electrical supply to the solenoid until the driver applies more accelerator, depleting the manifold vacuum.



When engaging overdrive, current is supplied from the ignition switch via the driver's switch to the relay. This then closes the contact in the relay, allowing current to flow directly from the fuse unit, via the gearbox switch, to the solenoid.

Using the overdrive

As with a normal gear change, the overdrive is helped by easing the accelerator when engaging, and applying more revs when disengaging. However, the unit is designed to change smoothly without help from the driver. Hydraulically, fluid returning from the operating pistons is restricted, slowing the movement of the conical clutch; and, mechanically, the uni-directional clutch begins to take up the drive before the conical clutch has moved into engagement with the annulus.

Dipping the clutch for each change is not essential, but will reduce wear on the friction faces of the conical clutch and brake ring, and thus reduce internal stress. Switching the overdrive in or out should take only a couple of seconds, slightly longer on a well worn unit, and the take-up should be smooth and without slip.

Routine maintenance

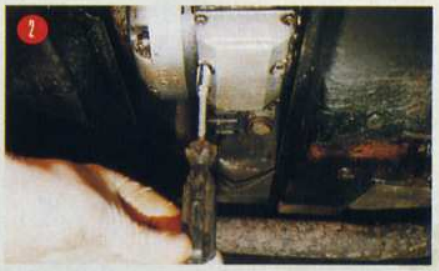
The overdrive unit demands little routine maintenance, with valves, seals and valve springs only needing to be removed for inspection when there is a problem.

The oil, which is shared with the gearbox, should be changed every 24,000 miles (40,000km) or 24 months, and the oil filters and magnets cleaned with petrol.

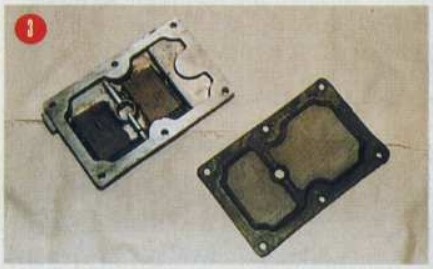
Cleanliness is essential to avoid any dirt entering the hydraulic system where it can cause blockage, damage to seals, and prevent valves from seating tightly; so make sure that you clean around plugs and sump covers before removal. Allow the new oil to fill slowly to the top mark on the dipstick, then drive a short distance, flicking overdrive in and out, before re-checking the level. Anti-friction additives should never be used with an overdrive as they will eliminate the essential friction between the conical clutch and the corresponding faces on the brake ring and annulus.

The photo sequence below shows you how to work on a later LH-type overdrive, although the earlier D-type is basically similar. Any unique points of the latter unit are detailed in the three photographs on the opposite page.

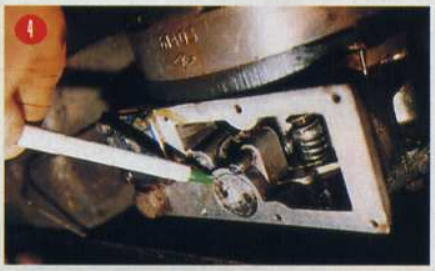
The overdrive and gearbox share the same oil, so drain both units through the gearbox drain plug and refill via the gearbox's combined dipstick and filler plug.



Next, release the six screws holding the overdrive sump plate and then remove the sump and its filter. Remember to use a tray to catch the remaining oil.

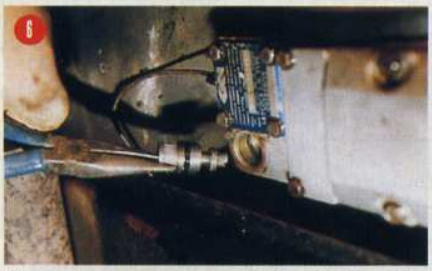


Wash the sump and filter with petrol and clean all debris from the two rectangular magnetic pads in the sump. (D-type has magnetic washers in its tubular filter).



The hydraulic pump retaining plug is set into the base flange, as indicated. Deeper inside the unit, one set of operating springs is just visible in this photograph.

Carefully unscrew the relief valve plug, collecting the sealing washer. Check the O-seal in the plug base and replace if it appears damaged or perished.



The unit can now be carefully withdrawn by gently gripping (use a pair of long-nosed pliers) the filter element which attaches to the relief valve.

Carefully and thoroughly clean all the components in petrol, and then check the O-seal on the valve body and plug for any damage or corrosion.

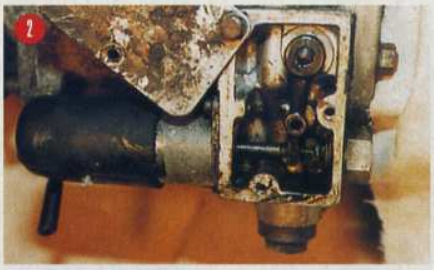
The solenoid unit is accessed by removing the manufacturer's nameplate. The plate itself states the type of overdrive unit and the serial number, by the way.

Flip the blade over to examine the double contacts. They aren't as critical as ignition contacts, and any arcing deposits can be cleaned off using fine emery on a flat surface.

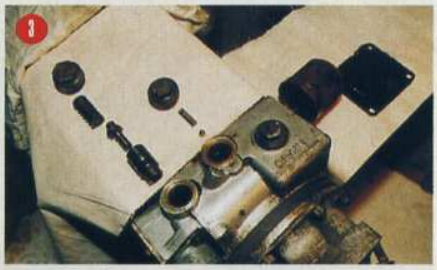
The solenoid can now be slid out. A defective solenoid cannot be repaired; it must be renewed. Check condition of the wiring.

Refill with fresh oil to the high mark on the dipstick. Run the car for a mile with and without overdrive, then recheck the level.

The D-type has the manufacturer's plate on the side, covering the solenoid levers. The iron brake ring is sandwiched between the casings.



The solenoid plunger on the D-type unit has an adjustable stop which must be set accurately while the solenoid itself is energised.



The valves, springs and filters are accessible from the underside of unit. Magnetic washers are fitted behind the sump filter.

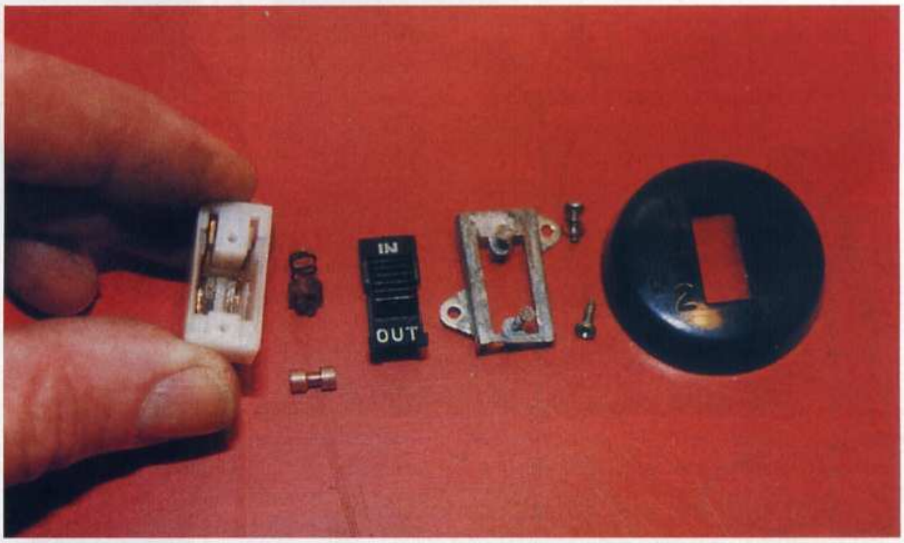
Fault finding

Laycock overdrives are well proven and reliable, so when things go wrong check the electrics first, then the hydraulics, before turning to the unit itself. Where internal defects are suspected the overdrive should be entrusted to a specialist, bearing in mind that a reconditioned unit may be the most cost effective solution. If the unit needs to be stripped it is important to list the precise symptoms encountered under all conditions beforehand so the defective parts can be quickly identified.

Much can be learned by attaching a pressure gauge to the overdrive to check the pump pressure and the rate of rise and fall in pressure as the overdrive is switched in and out. The rear wheels should be supported clear of the ground with the engine running and fourth gear selected, showing around 35mph on the speedometer. Oil pressure should be less than 40psi with the overdrive switched out, rising to 540-560psi (D-type) or 400-420psi (LH-type) with overdrive engaged. The pressure should rise and fall swiftly.

Slip a fine screwdriver under the forward edge of the gear cap to prise off the switch housing and pull off the two wires to test continuity.

Gearlever-mounted switches are more troublesome than the earlier dash-mounted types, but are easily dismantled to clean the contacts and check for a broken coil spring.



Electrical fault tracing

Check that power is reaching the solenoid by testing each connection from the fuse box and ignition switch through to the solenoid using a voltmeter or test lamp. Doubtful parts can be temporarily by-passed with a jump lead. If power is confirmed to the solenoid, try using an independent earth lead connected between the solenoid's outer casing and the vehicle body. D-type solenoids emit a faint click as they operate, proving the power supply is intact. D-type solenoids can be affected by moisture, but are usually coaxed into action by manually moving the control rod.

Where an intermittent defect is suspected, connect a cable to the lead at the solenoid and route it into the car, via a light

Use a meter or test lamp to check the circuit at each junction in the electrical supply, to identify faulty components and breaks in the circuit.

bulb or meter, to earth. The bulb will light each time overdrive is selected and will extinguish if the circuit is broken. The cable can then be connected progressively further along the circuit to find the fault by elimination of sections.

Hydraulic fault tracing

Low or leaking oil pressure may be due to a blocked filter, weak valve springs, worn O-seals or damage to the ball valves and their seats caused by dirt and pitting. Gently tapping a ball onto its seat using a soft drift will often restore the seal faces. Low oil pressure may cause slipping in overdrive, and oil which is too thick may restrict the speed of movement of the conical clutch. This is common during cold weather, until the oil has time to warm up, so don't worry if the overdrive refuses to engage for the first couple of miles.

Partial seizure of hydraulic valves and pistons, or leakage at valve seats and O-seals, will cause the hydraulic system to pressurise and de-pressurise slowly, resulting in slow changes. On the D-type, oil drains back though a restrictor which slows the movement of the pistons to produce a smooth change back into direct drive; partial blockage of the restrictor will cause a delayed change. These effects are especially noticeable during overrun, and can be confirmed by a pressure test. If the problem is hydraulic the pressure will rise and fall slowly, or fail to alter, as the overdrive is switched in and out. If the pressure rises and falls quickly, as it should, the problem is mechanical – probably worn or glazed friction surfaces on the conical clutch.

Mechanical fault tracing

Most mechanical defects involve the conical sliding clutch, its operating pistons, and return springs. The clutch may stick to the annulus, preventing the overdrive from engaging, but can often be shocked free. Do this with overdrive switched in during overrun at around 30mph in third gear. Dip the clutch pedal and let it out with a thump, but don't overdo this – if the conical clutch is still stuck after a couple of tries the unit will need to be stripped.

The conical clutch may also stick against the brake ring, leaving the unit jammed in overdrive. This is more common on reconditioned units where the new parts have not bedded in and can usually be freed by several sharp blows against the brake ring using a mallet. If it doesn't free, the unit will need to be stripped. If it does free, and sticks again, suspect corrosion on the brake ring face caused by water mixing with the oil. This can be rectified by temporarily replacing the oil with engine flushing oil. Flush the unit by running the engine in gear at 20mph with the rear wheels supported off the ground, switching in and out of overdrive for a couple of minutes, then drain and refill the unit with the correct oil.

At the other extreme, a conical clutch that fails to grip the brake ring or annulus may cause a slow change, or produce slipping in overdrive. The likely cause is worn or glazed friction surfaces, in which case the components will need renewal.

When the unit fails to engage or slips in overdrive, the car can still be driven in direct drive. But if the overdrive has engaged and won't switch out, the fault needs immediate rectification, though the car can be driven home keeping the engine load as light as possible in the low gears to avoid over stressing the internals. Reversing with overdrive engaged will almost certainly destroy the uni-directional clutch. MGW

Troubleshooter

FAILURE TO ENGAGE

- Conical clutch sticking on the annulus friction face
- Oil level low or incorrect or contaminated oil
- Internal component damage
- Electrical defect
- Low hydraulic pressure

FAILURE TO DISENGAGE

- Internal component damage
- Electrical defect
- Solenoid sticking or incorrectly adjusted
- Conical clutch sticking to brake ring
- Clutch operating springs weak or broken
- Hydraulic defect
- Blocked restrictor jet in operating valve (D-type only)
- Vacuum switch sticking (D-type only)

SLOW CHANGE

- Hydraulic defect
- Worn or glazed friction surfaces on the conical clutch
- Oil level low or incorrect or contaminated oil

CLUTCH SLIP IN OVERDRIVE

- Oil level low or incorrect or contaminated oil
- Hydraulic defect
- Worn or glazed friction surfaces on the conical clutch/brake ring
- Solenoid sticking or incorrectly adjusted

CLUTCH SLIP IN OVERDRIVE DURING OVERRUN

- Worn or glazed conical clutch linings
- Broken circlip on sun wheel (LH only)
- Solenoid operating lever adjustment (D-type only)
- Blocked restrictor jet in operating valve (D-type only)

Specialist suppliers

Autogear (Transmissions) Limited, 254 High Street, Canvey Island, Essex SS8 7SY; tel: 01268 681608; fax: 01268 681008 *(parts and reconditioned units)*

Overdrive Repair Service, Unit C4, Ellisons Road, Norwood Industrial Estate, Killamarsh, Sheffield S31 8JG; tel: 0114 248 2632 *(unit repair and reconditioning)*