5-Speed Conversion Overdrive

Vitesse/Mazda 5-speed gearbox

Earth Strap
The final chapter

After the trials and tribulations of a rebuild then more problems just three years later I investigate a Mazda 5-speed conversion by Vitesse Global Ltd.

July 17th: After a couple of weeks of pondering I arrange a test-drive of the Vitesse engineer's roadster V8 conversion travelling there in Vee to get a back to back comparison - carefully! A very different driving experience in the car as a whole with large capacity Rover engine, fuel injected, modified suspension and what felt like power steering - took a bit of getting used to, and unsurprisingly the gearbox itself is very different as well. Very light changes - finger-tip from 3rd to 4th for example, but with a positive detent action confirming it was in gear. I was looking forward to no longer having the baulking trying to select 1st or reverse from a standstill ... until I read an MX5 5-speed page with people saying they get baulking in reverse! We shall see. I did make a comment on the test drive that I have never had a gearbox yet where it **never** happened, and the chap with me didn't comment. (*November 24: So far I think it has baulked once in 1st and definitely has once in reverse in less than 1000 miles*). Many comments about 'ideal ratios', it's never been a issue with the torque of the V8 unlike the roadster where pulling away uphill you need more revs in 1st and 2nd before changing up as there is quite a big gap compared to between 3rd and 4th (some 57% as opposed to 38% for the 4-cylinder with 58% and 26% for the factory V8). Reverse is in the same fore and aft plane as fifth (but with an interlock to prevent you going direct from 5th to reverse without going across the the left in neutral first) where ideally it would have been 4th and 5th and reverse with a 'dog-leg' first. The biggest risk is that it's of course possible to go from 3rd to reverse if you happen to put a bit of sideways pressure on the lever (which I have managed to do once) when aiming for 4th. But you can't have everything, so I've decided to go with it - The pre-sales information and support from Vitesse has been faultless. I know I'll miss the overdrive as it is just so good to flick the column stalk for overtaking, but it's either go with the 5-speed or sell the car with a suspect gearbox. Installation to start in just under three weeks, should take one week. I'll have all the 'old bits' back and take a view on what to with them later on. Good factory V8 boxes can fetch up to £1k, I may decide to keep it with the car as I have done with the original block for the next custodian. I may have a look at what might be wrong myself, I'm unlikely to pay out more money to have it 'fixed' yet again when I'm not going to use it. A few weeks later I took the side cover off and reckoned I could see what the problem was. In October I launched into a near-complete strip-down to find the problem - not exactly what I had thought but even simpler, and fixed it for the princely sum of £3! Subsequently sold the whole kit and caboodle from clutch to prop-shaft plus cross-member at a fair price to someone wanting to reverse an LT77 conversion, so we were both happy.

August 5th: I deliver Vee to Vitesse at Hinckley and get two trains and a bus back home, expected completion one week. However I get a phone call on the Wednesday asking if it would be possible to delay it by a couple of days as they are having problems installing fuel injection on the previous job. Obviously I'm keen to get the car back, but I know it's not a good idea to park a job for something else half-way through then have to go back to it, and we are in the main holiday period with some staff away, so I agree as I don't want them rushing my job either. In the meantime I've sent the speedo off to Speedograph Richfield (recommended by Vitesse) for recalibration, and to clean it up after the faulty speedo drive pinion oil seal from the OD refurbish had leaked, contaminated the speedo and left the ODO wheels mucky. The initial estimate of £180 (recalibration only via Vitesse £65) was to include changing the wheels so I sent it off complete with correspondence and got a firm quote back of £125, I put the lower cost down to the fact that the speedo was otherwise sound and functioning correctly.

Two weeks later it comes back - and the odo wheels (with the possible exception of the 10k) are still mucky! Not best pleased. Email them and get an apologetic letter back saying if I send it back to them they will replace them - which means another £10 postage and another two or three week wait, by which time I should have the car back and be wanting to drive it - without a speedo! I could leave it, but before all this I was aware of the mucky wheels every time I looked at the mileage so will send it back ... after checking that it has actually been recalibrated! Expecting a gap between car and speedo return at the outset I've put a speedo app on my phone so can use that. I hope this isn't a sign that I should have cut my losses and sold it.

More gloom when I get an email with photos showing both inlet manifolds cracked between the front and rear pairs, and oil pooling on top of the inlet manifold gasket. They offered to take the manifolds to a local TIG welder but couldn't give me an idea of price or timescales, and as they hadn't been blowing I declined - maybe a foolish decision:

They also offered to replace the gasket for about £80 without delaying the job. Ordinarily I would have accepted that but I know the front offside thread is weak and won't fully torque up, and I didn't want more issues to come to light with taking the manifold off, so declined that as well. I've done both jobs myself in the past so can do them again, and will helicoil the head thread first, maybe over winter.

August 15th: Vee ready with her new 5-speed box on the Tuesday, but easier for me to collect on the Thursday. Reversed the journey by bus and trains and a half-hour walk to Vitesse rather than asking them to pick me up although they did offer. Couldn't see Vee walking in through the gates until I got past a delivery van to see her suddenly come into view gleaming and resplendent because they had washed her - attention to detail. Had a bit of a chat with Wendy in the office then her and Christian down at the car. He said despite their best efforts the near-side manifold was now blowing, disturbing the manifold has unsurprisingly opened up the crack. One of the things that surprised me was that they remove the engine first and then the gearbox (as I did at home) as the two together are so unwieldy, despite having a lift and a large engine hoist in the workshop. That was a huge job just to get at the top two bell-housing bolts, but ironically the Vitesse bell-housing has a significantly thinner flange and the bolts are much more accessible for installation at least!

Another comment was that he recommended installing an earth strap between the block and the chassis rail somewhere as the original is removed along with the removable crossmember. I expressed surprise asking how the engine got an earth at the moment, as they had road-tested it after installation and I had started it up, and he said 'other paths'. I know they recommend fitting one in the self-install instructions and thought they would have done so as part of the turnkey operation, so that will be something to look at.

Then to get the old box into the back of Vee! Discussing it on my test-drive visit Wendy said they could put it in the box the Mazda gearbox comes in so that gives me a size and we measure one up minus it's feet which are several inches high - 100cm long x 44 high and 47 wide. Back home I make a 44 x 47 template and that will just go through the open hatch, and most of the way to the front with the seat tilted forward, and 100 long fits easily with several inches clearance to the roof at the front. In hindsight I should have taken the wheel cover carpet and rear seat back out, as with those in and cloths on them to protect against any oil but they had drained it at my request and put it in a poly bag so with that and being in a very stout cardboard box there would be little chance. As it was it only just went in with me pushing the rear cant rail up out of the way while two of them (not Wendy!) pushed and pulled, and it was in!

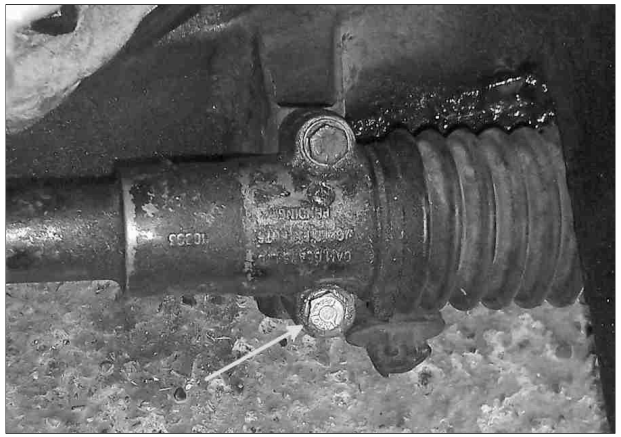
A bit of good news concerns the speedo cable. I'd previously asked about the length as the original 57" had to be removed and attached groping behind the dash, but the later 60" allows it to be pulled forwards. Asking about that earlier they just mentioned reaching behind the dash to attach, but in fact it projects forwards about as far as the 60" so it can be attached from the front. They had also put a cable-tie round the cable to stop the knurled wheel sliding down into the spaghetti behind the dash - more attention to detail:

And then the journey home! First stop a petrol station as I'd only been putting minimal fuel in while all this was going on, and a chap came up and said "You don't see one for years and then two appear within ten minutes!" Wendy had mentioned a black one was just about to leave but I was upstairs in the office and didn't see it. He had a 4-cylinder so a bit of a chat ensued, then after I had put a couple of gallons in an old chap doing a bit of cleaning up round the pumps also wanted a chat. Then I could get away. Got on the M69 and went for OD ... but of course I don't have OD any more, so select 5th instead. That started me thinking about 5th and reverse being in the same plane. The old box is biased to the 1/2 plane so you have to move it across to the right against spring pressure for 3rd and 4th. This box is biased to the 3/4 plane and you move it to the right against spring pressure for 5th and reverse, so I will have to be very careful not to knock it out of 4th or 5th while rolling along, then move it to the right and pull it back for 4th as I would have done with the old box ... because that will be reverse! Very careful, as of course I can still do that in Bee without causing a problem. That's probably the biggest short-coming with this box i.e. no 'lift' or detent in order to select reverse. The quid pro quo is that you can't hit reverse when doing a rapid down-change from 3rd to 2nd and going through the reverse detent as you can with the original boxes. On that subject reverse seems to have a shorter 'throw' than forward gears, so at first I think it has baulked and not gone in and needed a tentative lift of the clutch to confirm, but it has gone in.

Sounds and feels different although at the moment the near-side exhaust manifold is blowing - the disturbance of removal and replacement having opened up the crack (or not, it's actually blowing badly from one of the flanges) on the left-hand manifold, I'll get that sorted sooner rather than later and it is the easier one of the two to get off. There does seem more mechanical noise when driving - even idling there is a sound like the cooling fans running although quieter. This may be down to the gearbox mounting being different, but could also be the flexible pipe down from the clutch master cylinder to the slave cylinder inside the bell-housing and the bleed pipe coming back up resting against the body. In both Bee and Vee there was always slightly more mechanical noise when in OD which I put down to the additional epicyclic gearing, this makes a similar but quieter noise in all gears which I wasn't expecting. On further thought the MX5 probably has more sound-deadening! I also seem to be able to feel a draught on the palm of my hand while it is resting on the knob which puzzled me. Going into gears there seems to be 'detent' noise and feel which the original didn't have, but then that could be quite heavy (especially sometimes in Bee going between 3rd and 4th which has always been there) whereas this is very light in all the gears. With varying speeds on the M6 and M42 coming home I found I was leaving it in 5th, which the engine pulled perfectly happily, whereas I would normally have flicked OD out and back in as required, so something to get used to, I will miss that.

Back home and looking around under the bonnet I realised the prop had been refitted the wrong way round with the release lever at the back, so I corrected that.

Also noticed that the front rack mounting bolts had been fitted upside down (the rack has to come off to remove the engine as the exhaust manifold that side fouls it), the bolts should be fitted from the bottom as there is a section of weld inside the bracket to hold the bolt held while the nut is tightened from above so you only need one spanner/socket. They had also changed the front bolts, and fitted Nylocs underneath, with lock-washers which is odd.



Then looking round inside I could see the edge of the leather gear lever gaiter sticking out from under the chrome trim ring. Took the ring off (noticing they had the short screw at the side instead of the front and it hadn't picked up the threads) and realised they had unstapled the leather gaiter from the rubber gaiter. I had previously reversed and restapled it to prevent the rubber gaiter from pulling on the lever which was opening the gearbox switch and turning OD off, the V8 having OD in 4th gear only it only closes when the lever is pulled down into 4th as well as across. It's operation is marginal compared to the 4-cylinder where you only have to pull the lever across to the 3/4 plane to close the switch, and after 230k miles the mechanism was probably as worn as everything else. I restapled it back as it would have been originally and refitted the ring with the screws in the right places. With the gaiter off I can see the gearbox through the hole in the console tunnel and the socket for the lever seems noticeably offset towards the driver ... but in fact it is the console hole that is offset towards the left. The MGB gearbox remote housing is offset towards the left, Bee's being almost central to the hole, Vee's originally was a small amount towards the driver. This gearbox and the socket for the lever is central to the car and the lever needs a double bend to the left to centralise it in the hole:

The gear-knob had to come off for that, it has a 9/16" lock-nut underneath. I had already done that because since a visit to the Land Rover factory some years ago they gave me rubber 'sleeves' with Jaguar and Land Rover logos to cover my engagement and wedding rings, and I had put them on the lever afterwards as a keep-sake. I noticed they were missing when I picked up the car, but found them in a poly bag (one of several) with the old gear lever bits and pieces so refitted them. My gear knob is missing though which was an original for which I had to pay quite a bit to replace an after-market one. This gear knob seems higher than I

remembered and measuring it is 1cm higher. I did screw it down as far as it would go before tightening the lock-nut, but there are plenty of unused threads (3/8" UNC) on the lever (clearly visible from the driving seat and to the touch), it took 10 turns to 'bottom' on the lever so plenty of threads spare and I'll cut about 1/2" off.

After a 20-miler Sunday morning to get the paper a very early impression is that it's changed the character of the car. I remember years ago at a V8 event being asked if I wanted a 5-speed and I replied with a smile "Not while I can have a standard box with OD". Having now been forced into getting one that view has been reinforced. If it has a dodgy gearbox then the first choice should always be repair or replacement with the same - for me not an option with this having already had two rebuilds the last one less than 5k ago and a use box of the same type being an unknown quantity. Not being able to flick it in and out of OD with the column stalk is a huge loss, but what choice did I have? If I'd sold the car with a dodgy gearbox (at a considerable discount to its true worth) I would always have wondered what a conversion would have been like, at least now I know.

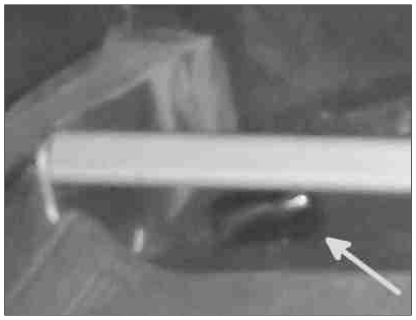
Subsequently I realise that the lever is noticeably thinner than the original at 0.375" as opposed to 0.447", so whereas before the top of the rubber gaiter was a snug fit to the lever there is a gap to the new one, and the noise is probably coming up through that gap ... and so is the draught I can feel! Pondering options I consider wrapping tape round to build it up with a bit of heat-shrink to stop it unravelling, then hit on the idea of a short length of hose. I have off-cuts of 1/4" and 5/16" but it needs 3/8" which I don't have, and that would only butt up against the top of the gaiter so may leave gaps or move around in different gears. Or successive layers of heat-shrink to build the thickness up to about .447" and fit inside the top of the gaiter like the original shaft - but I don't have any big enough. So I opt for layers of insulating tape and keep wrapping them round - the top of the rubber gaiter is less than half the height of the leather outer - until I can feel the resistance of the rubber gaiter going over them in trial fits. No heat-shrink for an outer layer to resist the tape unravelling, but as it's inside the neck of the rubber gaiter that should keep it in place. If not I'll get a piece of suitably-sized heat-shrink. Note the length of the thread:

I wrap some cloth round the gear lever, pushing it down through the hole in the centre console, and spread it out to catch metal bits while I shorten the lever with a hack-saw. But first I spin a 3/8" UNC die on to clean up the thread after it has been cut. Thankfully not hardened steel, I cut through in a few minutes.

Remove the die, drop the gaiters over and push the neck of the rubber one down over the tape, pop my JLR finger-ring protectors on, then the lock-nut to the bottom of the threads, then the knob which goes all the way down to meet the lock-nut, which I tighten up to the underside of the knob. The threads are now completely covered by the knob and any remaining bare shaft is covered by the finger-ring protectors - much better aesthetically, it remains to be seen what it has done to the noise and draught:

And the answer is that it has stopped both the noise and the draught, which I'm pleased about. After a 37-mile jolly on a sunny morning that involved inadvertently getting tangled up in Redditch suburbs which at least gave me the 'opportunity' to use the gearbox much more that it otherwise would have done, and once in gear either it is now the same as the old box or I'm getting

used to it. Or both. Changing gear the lever still seems to have a closer physical relationship to the mechanicals - the original lever seemed 'damped' by comparison, but the lightness and (so far) no baulking is good. One thing I'm noticing is that with the original boxes I rarely put the clutch to the floor to change gear but now I find myself doing so as otherwise there is more of a sensation though the knob.



I enquired about the original gear knob and they said it had been put in the footwell - where I found it, ironically appearing in the above photos but not noticed!

Coming back from another trip over our multitude of traffic calming measures there was a dull thump that sounded like something big was hitting body-work, also mentioned on the V8 Register account, that turned out to be to do with the engine steady bar. I noticed that the engine mount location plates had not been refitted to the underside of the chassis brackets for some reason, so possibly something to do with it. Then when looking at the nearside exhaust manifold thinking ahead to getting it off I realised the third branch was practically touching my heat insulation on the inner wing, whereas the other side there was getting on for a 1/2" gap! Then looking at the air-box it did seem to be tilted down to the right (looking in from the front), and a spirit level showed it was half a bubble down that side. Having an engine steady bar the easiest thing (pending looking at the engine mounts) was to adjust that, and it did seem to be pulling the engine practically all the way to the nearside. So I slacken the Nyloc nut on the inboard side of the head bracket many turns. I try turning the outer plain nut but it is locked to the inner nut, and I don't have a 3/4" spanner thin enough to hold that one while I turn the outer. Both plus the bar are turning together, so I have to grip the bar with Stilsons and that does allow me to turn both nuts to push the top of the engine towards the offside. I keep going until the spirit level bubble has moved to the other side, and it has opened up a bit of a gap between the manifold and the inner wing, but not much. Looking at the mounts the near-side is definitely lower on the chassis bracket than the offside so I'll see about refitting the location plates.

Three weeks after sending the speedo back to Speedograph I have heard nothing - not even confirmation of receipt as asked - so phone to be told "We were waiting for the orange wheels, they have come in today so I will be assembling it and it will go out in the post first thing tomorrow". Firstly I have no confidence that I'm being told the truth when you chase someone and they say it 'arrived today', and why aren't things collected by the Post Office at the end of the day instead of first thing in the morning? Three days later still nothing so I'll be making another phone call this afternoon and asking for tracking information. However I had no delivery info for the first time it came back, so I'm not hopeful. Clive Wheatley said 'not to bother' getting it recalibrated! Oh well, too late now. Call again to be told about some problem or other, should have gone out last night but didn't, will send it Special Delivery today and I should get it tomorrow morning! We shall see ...

And wonder of wonders it arrives with nice clean wheels. Another £54 to pay which I wasn't surprised at as the formal quote was less than the estimate at initial enquiry. After only a brief trip out at no more that 35mph it seems to be over-reading by the legal maximum of 10% compared with my smart phone speedo app. Irritating, previously (and Bee) it was only 1% or 2% over at most speeds. Needs a longer/faster run to be sure, and see what the mileage is doing. Over several runs the mileage is pretty-well spot on, but the speed is consistently 10% if not 11% over. This is governed by the hair-spring in the pointer, which I'm not going to be able to do much about, but at the lower speeds I might be able to 'correct' it by resetting the pointer on the spindle, and that does the trick across the speed range.

Still, it's nice to get Vee back together again (mileage tweaked to add on what we had done without a speedo):

Earth strap: After a few weeks I decide to check the voltage between the engine and the body while cranking - which shows the amount of voltage being lost in that connection, to find it was about 1.3v i.e. less than 9v at the starter instead of close to 10v (with a good battery) so worth doing something about. How it's earthing now I don't know as the factory engine and gearbox mounts completely isolate it which means if the factory earth connection fails it can only earth through things like throttle, choke and heater cables plus possibly temp gauge capillary and speedo cable, which get hot if not smoke, as well as giving slow cranking. I've also read about someone with a braided clutch hose that exploded while cranking because it was carrying the majority of the current. Whilst cranking seemed 'normal' when I first got the car back the last couple of times in cold weather it has seemed a bit slower than normal, which was why I checked it.

Vitesse mentioned the now unused clutch hose bracket on the chassis rail and a bolt on the engine can be used for the earth strap, and the most sensible place for the latter seems to be the lower starter bolt. The starter has a pretty big bolt with a 3/8" thread (the hole in the earth strap terminals I had bought 5/16") so second choice would be where the flywheel cover is screwed to the gearbox casing. Both those are about 20cm from the chassis bracket so a 22cm braided strap is a nice fit. Always use braided for engine/gearbox earth straps for their flexibility with engine/gearbox movement, insulated stranded cables are intended for fixed items like batteries (having said that the 12v cable to the starter is insulated and stranded but it's free length is much longer which gives it more flex without strands fracturing). Comparing sources as I do, Halfords just down the road have one at £2.59 whereas the cheapest eBay is over £5. The hole in the chassis rail bracket is pretty big at 15mm so I'll need an M12 x 20.5mm shakeproof washer (outside serrations) to sit between that and the earth strap lug to ensure a good connection and two largish flat washers to clamp it all together. All a bit of a fiddle as well as grovelling underneath. A strap with 10mm terminations would have been preferable for that location.

But having just discovered that late 1980 4-cylinder models gained a more accessible engine earth strap from a gearbox bolt to the gauge hose connector mounting point on the heater shelf I wondered if that was a possibility on the V8. It could be but the gearbox bolts are recessed into the tunnel on the V8 more than the 4-cylinder and would probably need the air-box to be removed if not the carbs complete, and the V8 does not have the oil gauge connector or its mounting bolt. An alternative high position from an alternator bolt to an oil filter housing bolt was a possibility but I didn't want it to interfere with changing the filter - that's a bit of a fiddle anyway having to slacken the three housing bolts to get my chain wrench round the filter, and detach the outlet hose from the housing to make enough space to get the filter out and back in.

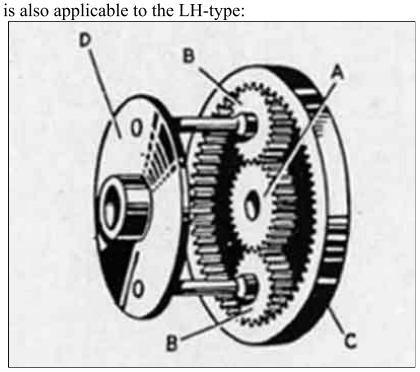
Another possibility is between alternator and radiator mounting bolts running past the other side of the oil filter, or the other side of the engine from the lifting bracket bolt, but I'm wondering if the relatively flimsy panel spot-welded to the inner wing is less than ideal as an earthing point. From a lifting bracket bolt to an expansion tank mounting bolt was briefly considered but the tank would no longer lie flat against that inner wing. From a lifting bracket bolt to a near-side wing mounting bolt, under the flange, is yet another, with a longer bolt and second nut (like the support bracket for the bonnet release cable) as the existing nuts are welded. Very little engine movement here as it would be right beside the steady bar, but the bolts are nicely painted and a new one would need painting to match. Which leaves underneath.

In the end, given that the diaphragm panel has got to be more robust that the clutch hose bracket, and it's much easier to get at, I opt for plan C i.e. between alternator and radiator mounting bolts which is by the oil filter but not in the way of its removal. In less than an hour it's on and there is now only 0.1v difference between engine and body so well worth it. A bit of a mystery as to why - when they recommend one for DIY installation of the gearbox - Vitesse don't fit one as part of the installation you are paying them for when they have a 2-post lift, but there we are.

The final chapter - I sell the car.

Overdrive

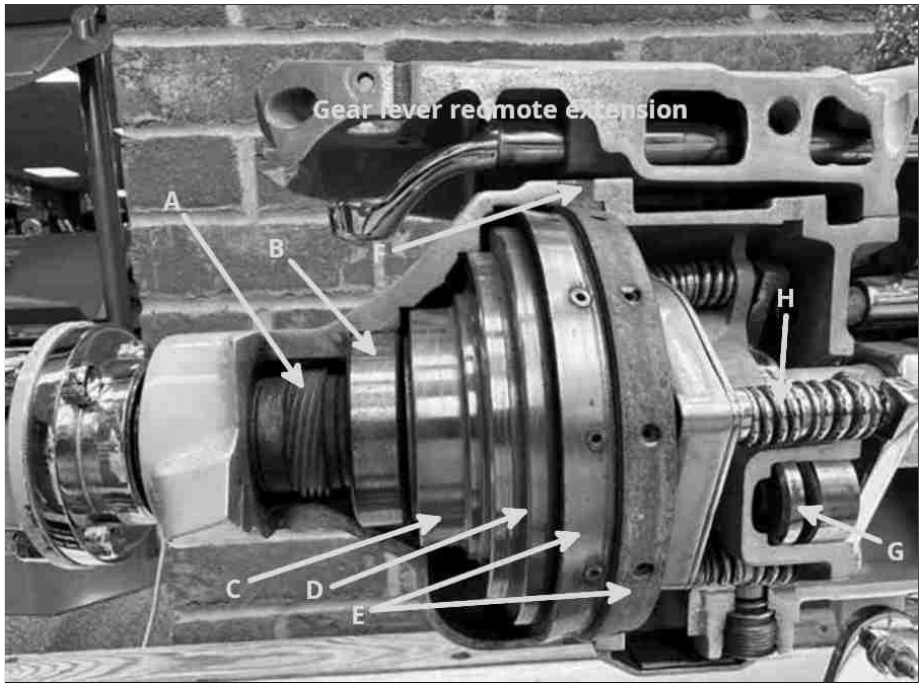
Although specific to the D-type OD the very clear description of how the Laycock overdrive changes ratios in this document is also applicable to the LH-type:



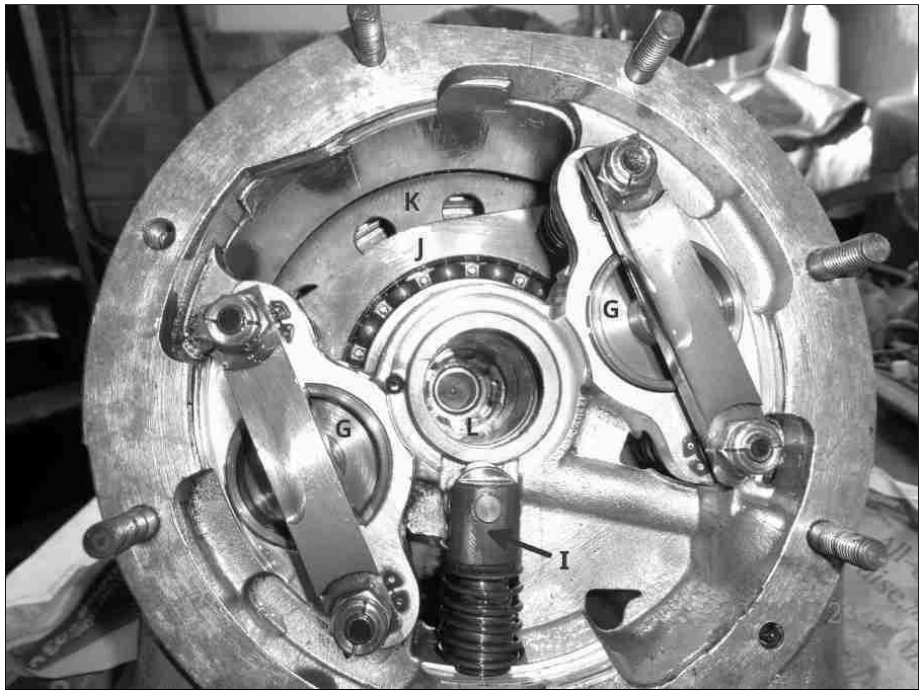
The gear train consists of a sun-wheel (A), planet wheels (B), planet wheel carrier (D), and annulus with ring gear (C) inside which drives the output shaft. The input is via the planet carrier and when the sun gear is locked to the ring gear the whole unit rotates as a single unit to give direct drive. But when the sun-wheel is held stationary the planet carrier rotation turns the planet wheels and hence the ring gear which is 'overdriven' at a higher speed than the planet carrier to give the overdrive ratio. Believe it or not this is exactly the principle used by the Sturmey Archer 3-speed hub dating from 1902 that many of us will have been familiar with when we were in short trousers. How does that give three gears? The Laycock unit always applies the input to one of them (the planet carrier), and either locks the sun-wheel to the annulus or to the casing to give either direct drive or the overdrive ratio. The Sturmey Archer does basically the same, but can reverse the input and output so that the ratio difference can either be used to gear the output down i.e. for first gear, or to gear it up for 3rd gear, with direct drive for second gear. Lots of videos and descriptions online, with varying degrees of complexity and confusion!

Understanding what determines the OD ratio is complex, and comparing the drawing above with endless descriptions of epicyclic gearing is no help. The ratio for the simple system above is determined by the number of teeth in the ring gear, divided by the number in the ring gear plus the number in the sun gear. The number of teeth in the planet gears has no effect. But the Laycock planet gears have two diameters - the larger engaged with the sun-wheel and the smaller with the ring gear and now the planet gear tooth count **does** have an effect ... and makes the calculation a lot more complex!

In this cutaway (I think of a D-type) 'A' is the speedo drive worm gear; 'B' is one of two output shaft bearings on the annulus output shaft (the other is close to the drive flange); 'C' and 'D' are the annulus that drives the output shaft - 'C' contains the one-way (aka sprag' or 'trapped roller') clutch and 'D' contains the sun-wheel, planet gears and ring gear; 'E' is the sliding member with internal clutch to the outside of the annulus (OD disengaged) and external clutch to the brake ring in the casing (OD engaged); 'F' is the brake ring in the casing; 'G' is one of two pistons and bridges that pulls the sliding member clutch away from the annulus and towards the brake ring; 'H' is one of four sliding member return springs: (*image from MGOC November 2024 Newsletter blog on the Laycock overdrive by Roger Parker - copyright information requested*)

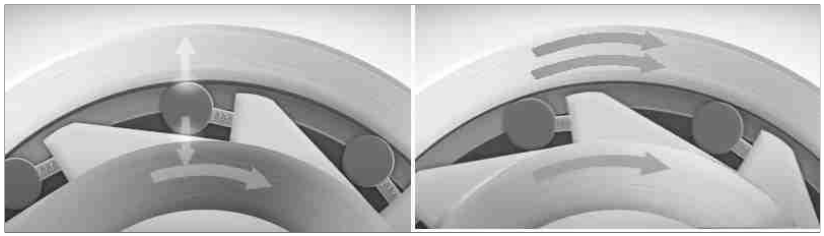


This end of the OD (LH-type in this case) bolts to the gearbox. 'I' is the oil pump; 'G' are the pistons and bridges, with rods passing through holes in the casting that pull the sliding member towards the viewer to engage OD; return springs 'H' behind the casting; 'J' is the sun-wheel bearing and carrier; 'K' is the sliding member with the planet wheel carrier seen through the holes; 'L' is the two sets of splines driven by the gearbox shaft for the planet wheel carrier (outer set) and one-way clutch (inner set) :



In use the eccentric cam on the shaft drives the oil pump. In direct drive the return springs 'G' are pushing the sliding member and its inner clutch 'E' away from the viewer against the outside of the annulus 'D' and the two are locked together. However forward drive is through the one-way clutch which has a set of rollers in wedge-shaped spaces that move to lock the sun-wheel to the annulus. With OD engaged hydraulic pressure pushes the pistons and bridges 'G' towards the viewer which pulls the sliding member and its clutches 'E' out of engagement with the annulus 'D' and into contact with the fixed brake ring 'F'. This stops the sliding member rotating and allows the epicyclic assembly to step up the gearing of the annulus and output shaft relative to the gearbox shaft. The annulus is now rotating faster than the sun-wheel which moves the rollers in the one-way clutch the other way and unlocks it. As OD is disengaged hydraulic pressure is released and the return springs 'H' push the pistons and bridges away from the viewer (to the left in the cut-away above) to push the sliding member out of engagement with the brake ring and into engagement with the annulus. All parts of the epicyclic gearing now rotate as one to give direct drive - again through the locked one-way clutch. While the sliding member is moving between the annulus and the brake ring the one-way drive is providing direct drive preventing any sensation of 'clutch slip' between its two positions. But the main function of the one-way clutch is in direct drive in a forward low gear to prevent any slippage of the sliding member clutch on the annulus under high torque conditions. In reverse the one-way clutch can't lock as it is rotating in the opposite direction, nor on the overrun (OD engaged or not) as the relative forces have reversed with the annulus race now driving the sun-wheel race. But in both cases 'helix forces' (WSM description) apply additional load to the sliding member clutches to prevent slippage.

The one-way clutch is worth looking at in more detail: (*Renold video*):



The one-way clutch is similar to a roller bearing except that rather than being held in a cage each roller is contained in a wedge-shaped space, and the two races can only move relative to one another in one direction, not both. The inner race is driven by the gearbox shaft with the outer race connected to the annulus and the output shaft. In the left image when the engine is driving the car forwards with OD disengaged the outer race wants to turn slower than the inner race, and the rollers are forced into the narrow part of the wedge. This locks the two races together and provides drive with no chance of the OD

clutch slipping under high torque in a low gear. With OD engaged on the right the epicyclic gearing is turning the output shaft to the wheels faster than the input shaft from the gearbox, hence the outer race is turning faster than the inner race, the rollers move into the wider part of the wedge and the clutch is unlocked.

Updated December2016: There were three types of LH OD for the MGB - chrome-bumper 4-cylinders cars; 4-cylinder rubber-bumper cars with different speedo drive gears and different colours for the solenoid cover/label. The V8 both CB and RB operates at a higher pressure but has the same speedo drive ratio as the chrome bumper 4-cylinder - theoretically with a different coloured label. The MGC also had the LH OD, details unknown. Speedos have the turns per mile (tpm) stencilled on the dial - 4-cylinder chrome-bumper cars have a 1280 tpm speedo and all V8s have a 960tpm speedo, whereas 4-cylinder rubber-bumper cars have a 1000 tpm speedo. On the face of it the V8 should have different speedo gearing to the chrome-bumper 4-cylinder, but they have different axle ratios as well which also has to be taken into account. The 4-cylinder ratio is 11/43 and the V8 14/43 i.e. 27% lower prop-shaft rotation of the V8 for the same road speed. But the V8 speedo would over-read by 25% with the same turns of the drive cable, so they almost cancel each other out, bar 2%. Another factor is the wider 175 tyre of the V8 but the same profile, which results in a 2.5% reduction in wheel and hence prop-shaft rotation for the same road speed. This seems to be resulting in an overall 2.5% reduction in V8 speedo reading for a given road speed, whereas perhaps one would expect it all to work out at 0.5% over-reading, but I must confess I can't be certain either way!

D and LH Type Differences

There are both ratio and electrical differences between the early and later ODs fitted to the MGB. The earlier D type has an OD 3rd ratio that is closer to 4th than the LH type - 73% as opposed to 65%. Thus the LH type has closer to a '3rd and a half' ratio than the D type, but both offer a useful mid-way point between 3rd and 4th for spirited twisty bits or a long steepish climb. In theory that should mean that the D-type has a higher road speed for a given rpm than the LH, and indeed it does at 22.3 mph in OD 4th at 1000 rpm compared to 22 mph exactly for the LH. But it has a fractionally **lower** road speed in straight 4th at 17.9 mph compared to 18 mph for the LH. How can that be when they both have the same diff and in 4th the gearbox ratio is 1:1? Probably just rounded to the nearest whole number with the later gearbox.

The D type is not as strong as the LH and has a vacuum switch and relay to prevent the driver from disengaging OD under certain conditions - high revs and no throttle - which could overstress the unit. The LH type does seems to be strong enough as the factory felt that 'driver education' was sufficient, although on the V8 breakages were found early on so OD was limited to 4th gear including retrospective mods. Note that the restriction of OD the 4th gear only on later North American models was solely due to complications with the gearbox switches and TCSA. The wiring and a description of the vacuum switch and relay circuit can be found here. The Service Instruction Manual for the D-type as fitted to Standard-Triumph vehicles can be found here.

LH Solenoid Covers/Labels

Cover gasket

Lots of different types around although most don't apply to the MGB. Of the numbers stamped onto the cover Vance Navrette writes:

> "The first 2 digits represent the percentage overdrive that the unit delivers.
> The TR J-Types delivered a 25% OD factor (e.g. for every revolution on the input shaft, the output shaft rotates 1.25 revolutions).
> TR A-Type ODs delivered a 22% overdrive.
> TR J-Type ODs delivered a 25% overdrive.
> Volvo J-Types delivered a 27% or 28% overdrive."

And Kai Radicke writes:

> "1953-1955 = A-type, non-synchronized first gear - 22/61275/ - TR2 up to TS5979.
> "1955-1964 = A-type, non-synchronized first gear - 22/61374/ - TR2 from TS5979-TR4 Oct. 64
> "1964-1967 = A-type, synchronized first gear - 22/61712/ - TR4/4A Oct. 64-67 solid rear axles.
> "1965-March 1971 = A-type, synchronized first gear - 22/61753/ - TR4A (IRS only), TR250, TR6
> "April 1971-November 1972 = A-type, synchronized first gear - 22/61985/ - TR6
> "December 1972-1974 = J-type, synchronized first gear - 25/115838/ - TR6
> "1975-1976 = J-type, synchronized first gear - 25/115876/ - TR6
> "22 and 28 are also common to Austin Healeys though (all Healeys used A-types).
> "Spitfires from 1974-1981 also used the 25 spec J-Type."

In common with many of the above MGBs used the 22% type, with a black label on CB cars and a blue on RB. There are said to be different colours for MGC and V8 to denote higher pressures perhaps, but opinions vary as to which was green (MGC?) and which was red (V8?). Overdrive Repair Services in Sheffield who are ex-Laycock engineers have told me that if they ran out of a colour they used whatever they had to hand, albeit with the correct numbers stamped!

The second group of numbers are initially five digits starting with '6', the remaining four digits going up in jumps. Then from the above apparently changing to six digits starting with '11', with the remaining four digits continuing to go up in jumps. This group could indicate small internal changes of design or component, but I'm guessing, they don't seem to relate to date unless it is a code. The final group of digits is the individual serial number of the unit.

The following are from 4-cylinder MGBs. The first pair carry the same numbers but represent two different eras of production changing in the mid-70s, see below. Of the second pair the black label should have a 1280tpm speedo drive gear and the blue label should have a 1000tpm speedo drive gear, but they both have the same reference number:

22/61972

22/62005

22/62005

Change in ownership - Laycock was sold to Birfield in 1938, and although GKN bought Birfield and hence Laycock in 1966 the units were badged Laycock/Birfield until the 'mid 1970s' (Wikipedia) when it became 'GKN'. However the '61972' of the top pair implies it could have been the very early 70s going by the dates above:

Bee's plate - '61972' seems quite common for 4-cylinder cars and is in line with the A-type sequence above. 'GKN' indicating that the badging changed by September 72 (Bee's build date) as well as the dates above:

V8s always used a 960tpm speedo drive i.e. for both CB and RB, this is Vee's plate. A number lower than one might expect for a 1975-built car and earlier than Bee's, although V8s probably had their own number series to represent the different operating pressure. Also the earlier 'Laycock/Birfield' plate, so maybe Vee has had a replacement OD ... which may have come from a 4-cylinder!:

The plate from a V8 owned by Geoff Dunlop in Australia that started it all - one of the higher five-digit numbers as on the J-types above. However some sources indicate this should be red with green being for MGC:

Reputedly an MGC plate with the same reference number as Vee's above although information is that they had a green label. MGCs seem to have had a 1020tpm or a 1120tpm speedo depending on which axle was fitted, which varied according to year and whether it had standard, OD or automatic transmission. MGCs also had 15" wheels with 185/70 tyres which result in a speedo under-read of 6% compared to the standard MGB roadster. So just like a black-label OD can drive a 960tpm V8 speedo, I suspect the same OD can be used for an MGC with a 3.7:1 axle and an 1120tpm speedo, or a 3.307:1 axle and a 1020tpm speedo. The second group of numbers does fit in with the dates given above for MGC production:

Solenoid Cover Gasket *March 2017* There is oil in the solenoid valve and although they have a gasket they, where the wire exits, and possibly the screw threads, can leak. Bee had started dropping clean oil recently, from the sump area, although given the size and shape of the gearbox and OD it could have been coming from anywhere and running to the lowest point. Note that although the solenoid cover (NOT the sump!) is at the lowest point it can be removed without draining the oil.

Originally I suspected the drive flange oil-seal, so tied a strip of white cloth round it between the flange and the seal, but it didn't stop the drip and the cloth was still clean. Next step was to tie a set of longer strips round the gearbox - in front of where the gear lever remote housing attaches, where the OD attaches to the gearbox, and where the rear half of the OD attaches to the front half. The drips still appeared from the sump area but to one side i.e. under the solenoid cover, so that was a likely candidate. It could also be the relief valve plug, and the sump gasket, but as certainly the latter and possibly the former would require draining the gearbox whereas the solenoid cover doesn't, I decided to tackle the solenoid cover first.

The screws (8mm socket needed) were barely tight, but rather than simply tightening them I removed the cover, cleaned the faces (although the gasket came off almost completely intact), and fitted a new gasket (37H1941) with a smear of non-setting flange sealant both sides and on the screw threads. Tightened the screws gradually and diagonally, using just a nut-driver and not the 3/8" socket handle. Oil does drip out steadily with the cover off, but no flood, not even when the solenoid and its plunger are removed. I left these alone as they weren't causing any problems, but if leaving the car with the cover removed it would be advisable to put a clean container underneath to catch any bits that may fall out under their own weight.

However that didn't fix the leak, and in fact the OD stopped working altogether when warm shortly afterwards. Electrical tests showed the problem was electrical, and turned out to be the earthing strips on the end of the solenoid coil having lost tension. I retensioned those, changed the O-rings as well, which fixed both problems.

Hydraulics:

If current tests show still show about an amp flowing when the OD drops out, then the problem isn't electrical, but is mechanical or hydraulic, some of which can be more easy to deal with than others:

- The LH solenoid has three O-rings, and if the medium-sized one of these should fail it may not develop sufficient pressure to engage OD, as it allows oil to escape as if the solenoid had failed to operate. Likewise if the plunger jams, or the ball (BLS106, 3/16") is not seating properly. The solenoid is accessible from underneath by removing the square information plate beside the sump, draining the oil is not required. Incidentally the small O-ring inside the solenoid assembly, and the large one on the top-plate, contribute to preventing oil leaks, as well as the gasket above the information plate, and the rubber seal around the solenoid wire.
- There could be problems with the relief valve, accessed by removing the hex plug by the sump, which can be done without draining the oil. This also contains a ball-bearing, but the usual suspects only show this as part of a kit and it is not separately identified in the Leyland Parts Catalogue.
- There is a non-return valve ball and seat in the pump which could be leaking back, or the plunger may have jammed if has not been aligned correctly or the return spring is weak. This ball and seat are only available from the usual suspects as a pair, and the ball is not separately identified in the Leyland Parts Catalogue. This is accessed by removing the sump, which requires draining the oil, and needs a special tool to remove the pump plug (or a pair of stout long-nose pliers with the ends in the holes, turned by grips). I've not had any need to dig-in to the pump but Nathan Peach came up with a really good check when he was investigating his after changing several parts but still not working. He found no oil in the new solenoid so suspected the pump, and after draining the oil and removing the sump he turned the prop-shaft while looking up inside the OD with a torch he could see the pump but it wasn't moving. He went to remove the pump but as soon as he turned the securing plug something

clicked into place, and after that he could see the pump operating. The end of the pump that carries the roller has a flat side and a rounded side - the flat side goes towards the rear of the OD, and it's this flat lying against the casing that orientates the pump correctly. Nathan also writes that the pump plug is a lot easier to fit if you use the prop-shaft to turn the lobe of the cam away from the pump!

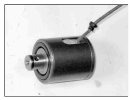
If all that looks good the only thing you can do short of removal and dismantling is use of a pressure gauge, which should show 400 to 420psi (510 to 530psi for the V8) with OD engaged, zero when disengaged. This needs an adapter fitted in place of the relief valve plug beside the solenoid, which can be done without draining the oil. This will obviously need the engine and gearbox to be run with at least one rear wheel off the ground, handbrake off, **and the car very safely supported**. Remember to switch OD in and out when doing a pressure test as you will need to note from the spinning of the wheels and/or relative changes in the speedo and tachometer readings whether OD is actually engaged when the pressure shows it should be. If the problem is that OD drops out after driving for a while then it will need to be run like this for an equivalent time to allow the fault to develop. Insufficient pressure indicates pump solenoid or relief valve problems, or dirt in the passageways. Correct pressure but OD not engaging indicates problems with the actuator pistons, again dirt in hydraulic passageways feeding them, or the sliding member (list not exhaustive, only indicative).

Overdrive Pulsing *Updated April 2017*

Since about 2012 Vee has exhibited a kind of 'pulsing' when switching out of OD after a long fast run, it's as if the OD is engaging and disengaging by itself. Last year someone reported the same thing on the MG Enthusiasts BB, and Stephen Strange of Virginia, USA posted the following:

> "One vexing symptom of an Overdrive problem that is not mentioned in the factory manual is a 'pumping' effect during engagement when the car is driven in direct drive, even though when driven in Overdrive all appears normal. This is caused by a problem that is very simple to fix. When the system is operating correctly, a buildup of hydraulic pressure from the pump is directed to the two operating pistons and moves the sliding annular clutch (conical clutch) unit. Its outer brake surface then comes into contact with the stationary brake ring, and then the complete sliding member and the sun gear will consequently cease to rotate. With the solenoid deactivated (i.e., Overdrive switches off), the solenoid plunger does not retract fully, and the springiness in the small O-ring at its tip is enough to push the piston and ball back into its seat once the pressure has bled off. This in turn causes the pressure in the actuating system to increase, which in turn causes the Overdrive to engage again. Past a certain level, there is enough pressure to force the plunger back a bit until the pressure bleeds off and the cycle is repeated again (at a frequency of about every 2 seconds). Normally, as the sliding annular clutch (conical clutch) unit of the Overdrive unit starts to move during the engagement process, the Overdrive unit temporarily loses engagement during the moment between when the inner lining of the sliding annular clutch (conical clutch) leaves its seat on the annulus and the outer lining contacts the stationary brake ring. This is event so brief that it is not noticeable, but in this case, the sliding of the annular clutch (conical clutch) never travels far enough for its outer lining to contact the stationary brake ring before it is pushed back again, so for about a second neither lining is in contact. As soon as the inner lining of the of the sliding annular clutch (conical clutch) engages the annulus, engagement returns with a jerk and stays for a second or so until the of the sliding annular clutch (conical clutch) is again pumped away, and the cycle then repeats itself. The solution to this problem is very simple: fit a thicker gasket under the solenoid cover plate. This will allow the piston to move a bit further back before hitting the solenoid cover plate, the extra movement being enough to make the O-ring slide down into its bore instead of simply compressing a bit and functioning like a spring."

I had some questions about the described cause and cure, subsequently found Paul Walbran's web page (scroll down to Overdrive "Pumping") that at the time described the same problem and solution, and left me with the same questions. As far as a thicker gasket goes, the standard gasket has a large hole which allows the base of the solenoid to sit against the cover. Adding a second or thicker gasket of the same design won't change that, so the plunger will still only move back the same amount relative the solenoid body - which contains the valve seat and ball - as before. Also allowing the solenoid body to come back further will cancel the function of the large O-ring which is to prevent oil leakage down the side of the solenoid body. Also giving more space for the solenoid body could allow the top or the base to move away slightly from the main part of the body, which will reduce the tension on the earthing spring on the end of the solenoid coil. I found even putting sealing compound on both side of the cover gasket, in an attempt (failed) to cure an oil leak, was enough to affect the earthing and hence the electrical operation. One would have to fit a non-standard gasket which held the solenoid body away from the cover - and in the original position relative to the OD body to overcome the problem of oil leakage and coil earthing, but with a smaller hole that allowed the plunger to come back to the cover, to increase the clearance at the valve. However by insulating the solenoid body from the cover you are removing one of the paths through which it can earth, and it will be dependant on a much lighter contact between the sides of the solenoid body and the OD body.

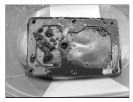


As it has only started happening after 20 years and nearly 100k, I tend to think it is not simply lack of room for the plunger, but something else. The small O-ring Stephen mentions is **not** at the tip of the plunger, but sits in a groove further down, and prevents oil seeping down to the external cover from where it will almost certainly leak, despite the gasket and the rubber seal on the wire. It could have swelled with age, making it more difficult for the plunger to slide back down when the coil is de-energised, but it would have to be resisting close to 510psi in the V8, which seems unlikely, and normally O-rings compress with age and lose their sealing function. As the plunger normally is able to move at least 2mm, the question has to be asked - why that is that not enough? It could be an obstruction below the plunger, or in the valve assembly at its tip, or in the relief valve assembly.

Incidentally a very similar pulsing can occur with low oil level, but only when overdrive has been selected. In that case there is insufficient oil pressure to keep the sliding clutch fully engaged with the brake ring, and it pulses between OD engaged and not engaged, in drive as well as on the overrun.

2019: Since Vee's engine and gearbox came out over 2016/17 for an engine rebuild but no work on the gearbox or OD I've not had any pulsing ... but quite possibly because it is now dropping-out electrically on the overrun, with the gear-lever moving forward slightly. I can keep it engaged by pulling the lever hard back and towards me, but it's not something I like doing. I replaced the switch and spent some time fiddling with its shims to no avail - I could reduce them to the point that it would engage pulling in 3rd but still drop out in 4th overrun. With the gearbox now whining it has to come out again, and I shall investigate the linkages that operate the switch.

Overdrive Replacement *June 2013*



A pal has a supercharged roadster and had been having various problems with it failing to engage and disengaging once engaged. Whilst some of the problems seem to have been electrical and were fixed it was still disengaging, and it seemed to be on sudden changes of direction i.e. overtaking i.e. as if 'oil surge' was causing oil starvation. Low oil level could cause that, but of course that had been eliminated as a possibility some time previously, so he decided to do an oil change and remove the sump and filter. There was a considerable amount of what looked suspiciously like friction material lying on top of the filter - which was quite probably restricting the rate at which oil could pass through the filter into the sump to be picked up again by the pump! After a bit of pondering and discussion with Overdrive Repair Services in Sheffield it was decided the best option was to send it to them and as well as any repairs they would uprate it to V8 spec to cope with the additional torque of the supercharger. He and another pal got the engine and gearbox out as one, removed the OD, parcelled it up and sent it off. He got a nice shiny one back in little more than a week, and I was co-opted to help fit it and do an opportunistic change of the clutch, slave cylinder and slave flex hose at the same time.

First task was to split the engine and gearbox, and the biggest problem was to support the engine partly on the hoist to stop it falling over, and partly on blocks to stop it swinging about, and support the gearbox such that as the two are unbolted there is no tendency for them to change angles in different directions and put a bending force on the first motion shaft. Really quite difficult, and having split them both ways now I would never ever contemplate removing both if all I were replacing was the clutch. Even if doing something with the gearbox, if I could get the car high enough I would still remove the engine i.e. while the gearbox is firmly attached to the car, then remove the gearbox separately (as I did for the V8 gearbox). This was reaffirmed when it came time to put the two together, as there is a limit to the amount of weight two blokes of a certain age can manipulate in four directions while trying to get the splines re-engaged, but more of that later. The crucial thing is to keep an even gap all the way round between the bell-housing and the engine back-plate, while you are separating and joining the two.

With the gearbox off we decided to go for the interesting bit first and refit the OD. For this we had a Workmate to stand the gearbox on its bell-housing so we could lower the OD onto the other end, also recommended by the people in Sheffield. They supply a gasket for the OD/gearbox join which is proper gasket material, and not the flimsy paper effort supplied by one of the major parts houses. Although the proper gasket, being thicker, will have more ability to cater for minor imperfections in the two flanges, we decide to go for belt and braces in the shape of a smear of non-setting joint sealant on both faces of the gasket.

IMPORTANT! The LH overdrive is attached to the gearbox with the solenoid and the manufactures info plate on the bottom. Unlike the D-type where they are basically on the side, which is how one MG 'specialist' used by an MGOC forum member attached an LH OD, only discovered when engine and gearbox were back in the car and he was struggling to understand how the speedo cable ran.

There are two aspects to be considered when fitting an OD to a gearbox. One is the splines of which more later, and the other is the hydraulic pump cam on the gearbox and the pump plunger on the OD. There is a slight chamfer all round the edge of the cam, and I wondered if this would enable the pump roller to slide onto the cam as the two were pushed together if the output shaft was turned to present its lowest profile to the pump roller. Both the Leyland Workshop Manual and Haynes use the hallowed phrase "To refit, reverse the removal procedure" - it most certainly is not! I took the cam off the gearbox output shaft - be aware there is a ball bearing in a depression in the shaft which engages in a slot in the cam to drive it, make sure that doesn't fall out!! - and held the cam in the position it would be inside the OD, and it was obvious the pump shaft will have to be pulled back against its return spring at least 1/8" before the two will engage, much more than the chamfer. John Twist recommends grinding a bigger chamfer on part of the cam, but I didn't think much of that idea. We used a length of braided nylon cord that happened to be handy, fed through between the pump shaft and roller, the shaft can be pulled back against its return spring pretty easily with that. The two casings are only about 1/4" apart as the roller meets the cam, so not much space for anything else. But to make things easier it helps if the output shaft is turned so that the cam presents the lowest part of its profile to the pump roller. Easily done, but you are going to have to rotate the OD output flange to align the splines, which could easily turn the gearbox output shaft as well. So as the gearbox was on the Workmate we simply put the gearbox into a gear (any gear will do), turned the cam to the correct position, and closed the workmate jaws onto the first-motion shaft to lock the cam in position.

We picked up the OD and turned it open end down ... and about a cup-full of oil (presumably the residue of what was used for their testing) ran out going all over where we didn't really want it. Lowered the OD over the shaft, and it went down until the studs just started to go through the gearbox casing holes, and stopped at about a half-inch gap. We thought that might be the pump roller on the side of the cam, so pulled it back with our cord. It moved back and fore freely and made no difference to the gap between the casings, so it must be something else. Looking inside the OD there are two sets of splines, one in line with the other. One of the people at Sheffield had said something about 'moving the lower splines' which didn't make much sense at the time, especially as he qualified it with "But I only repair them, I don't fit them". At first sight they appeared to be in line, both turning as I turn the output flange, so we have another go with the same result. We then made a crude depth-gauge from a long screwdriver and a bit of masking tape to measure the distance from the edge of the OD casing to where the two splines meet, and compared that with the gearbox output shaft adding on the half-inch gap, and it came right to the end of the shaft, so the shaft must be going through the first splines, but not the second. A closer look at the two sets of splines shows that although one side appears to be in line - the side I looked at first, the other side is noticeably out of line! So a quick call to Sheffield to clarify 'moving the lower splines' and it turns out the inner set are on the one-way clutch, and if you turn the output flange one way the two sets move together, but if you turn it the other way they can move apart. They are set correctly at the rebuilders, but can move in transit, and maybe if you turn the output flange. What you have to do is put a long screwdriver down inside the splines, hold the output flange, and turn the inner set **anti**-clockwise relative to the outer set (they won't move the other way because of the one-way clutch) until the splines are exactly in line. There are no instructions with the OD about refitting it, I don't think it would hurt them to include something to this effect. Subsequently (with another one to refit sometime) it occurred to me that a flat bar of the appropriate width and thickness to replicate two opposing splines on the gearbox output shaft would work well as an alignment tool, measuring the shaft comes out at 1 1/8" diameter at the splines i.e. a bit less in the recesses of the OD, and each spline is 9/32" wide i.e. a bit more in the OD.

Anyway, with the splines aligned we tried again, and this time the OD stopped about 3/4" short, with the studs clear of the gearbox casing! This must be the first set of splines not aligning this time, so pure luck that they did the first twice we tried. The only way we are going to correct this is to turn the output flange, but which way so that we don't upset the alignment of the two sets!? Now if we had to turn the inner set anti-clockwise relative to the outer set to align the two sets, because it won't move clockwise, then it stands to reason that if we turn the outer set **also** anti-clockwise then the two sets will be locked and so not move out of alignment - OK? A quick practice in the air - anti-clockwise looking into the splines will be clockwise looking down on the flange, and I go for it. I turn the flange, then feel a tiny click, which is probably the splines **almost** engaging. But have I gone to far? I can't turn it back or I could misalign the two sets of splines again, so carry on turning clockwise but slowly, and feel another faint click. This time we waggle the OD a little bit, and it drops, this time with about a 3/8" inch gap. So now we pull on the cord, and bingo it drops the rest of the way - barring the thickness of the cord. So very carefully easy the OD up again about 1/8", and pull the cord out. This is where cord is probably better than wire, anything strong enough might be difficult to pull out and leave scratches.

Annoying, as with a solid shaft once fitted the two sets of splines never move relative to one another, so if they had locked them together in some way when building up the OD the job would have been so much easier.

October 2024: Having taken the easy way out and had a 5-speed conversion from Vitesse after the second bout of gearbox problems in less than 5k miles I brought the whole lot back as I had a good idea of what was happening which shouldn't have been, which turned out to be correct, but the cause was even simpler than I had imagined. So once corrected and reassembled I advertised everything on the V8 Register web site and only about a week later someone contacted me to buy the whole installation as they were going to reverse a poorly done 5-speed conversion using an LT77 on a factory V8 bought as a project. Up to that time I hadn't refitted the OD as someone might want just the gearbox and would reuse their own OD, but the purchaser wanted it fitted. Done it once before, how hard could it be? Set about it one afternoon and repeated attempts to get the splines to engage failed, so after a couple of hours I decided to leave it and ponder. I was doing it on the floor (on wood blocks to protect the 1st-motion shaft) whereas before we had got it up on a Workmate - which I wasn't going to be able to do single-handed. So the gearbox shaft was turning as there was nothing to hold it still while I was turning the OD output flange. Lifting up, turning a fraction and putting it down wasn't working, and I had to keep resetting the splines, so I felt I would need to clamp that shaft somehow. I wondered if I would be able to use my Workmate when collapsed so I only had to 'dolly' the gearbox onto it rather than lift it, and clamp the shaft in the jaws, and that proved to be the case. Hyper careful to get the splines aligned, it's very easy to go just a fraction too far, and I was finding the smallest amount was enough to prevent full engagement. So I erred the other way stopping so the trailing edge was the merest fraction short before the leading edge started protruding. Placed onto the shaft and the outer set had not engaged. Turned the output flange slowly clockwise, and it suddenly dropped down with a different sound to before ... and the second set had engaged first time! Then just a moment to jack it up a bit to pull out the cord, and we are home. So putting the gearbox in gear and clamping the 1st-motion shaft must be considered as essential.

And then a sudden realisation - it's extremely difficult to get them **exactly** in line poking a screwdriver down inside the OD, and if the inner splines are even fractionally past being in line with the outers then because of the one-way clutch the shaft has no chance of nudging them back into exact alignment. But if they are fractionally **short** of being in line then there is a good chance of them being nudged into line as you lower the OD onto the shaft!

It's now just a case of putting the lockwashers and nuts on the OD studs ... or is it? Two of the studs don't have enough clearance to get the nuts under, so again we have to ease the OD up just enough to get the nuts under, but not enough to get the roller off the cam! The easiest way of doing this is to use a flat-bladed screwdriver under one of the studs and


lever up carefully while lifting the OD until there is enough space on the other stud, and a couple of finger-tips to get the threads started. The screwdriver keeps the gap consistent, you don't want to drop the stud onto the nut and risk damaging the thread. With that nut started and on a few turns, lever under that one to lift the other stud and get the washer and nut on that. With the second gearbox and OD one of these nuts just slid under the stud but the other needed the lever. With those two on the other six are easy, then time for a well-earned bacon sarnie!


Well, I say the other six were easy, but with the second gearbox and OD two more were awkward as well being in angled recesses above where the cross-member attaches. Not only to get the nuts started, but they need a very slim 7/16" open-end spanner to get enough of a swing in the angled recesses to tighten them one flat at a time, even a slim ring-spanner won't go on. Although the first installation was on a 4-synch gearbox and the second on a V8 both use the same rear extension so just casting differences.


After that we change the clutch, then more struggling getting the gearbox back on the engine, keeping it square and aligned in four orientations while turning the OD output shaft (gearbox still in gear) to align the splines, reaffirming that separating and reattaching them in the car is by far the best way (short of using an engine stand). *February 2018:* However it subsequently occurred to me that by using, say, four long shafts or studding about the same diameter of the bellhousing bolts, long enough to engage with both halves before the first-motion shaft starts to engage, that would certainly help in keeping the two halves correctly aligned whilst pushing them together. Then refit the remote tower (which has to be removed to remove and refit the OD), and most important - attach the gearbox harness to the switches, solenoid wire and gearbox and engine bracket points before putting the whole back in the car! Final job of the day is to change the clutch slave and flex hose, the latter can be really difficult on the 4-cylinder with the engine in-situ. Reinstallation of engine and gearbox to the car is a job for next day.

Overdrive Sequencer Relay

October 2016: For Graham White's version, with added features such as automatic disengagement when changing between 3rd to 4th, and 'belt and braces' ensuring OD cannot be engaged with reverse, see here.

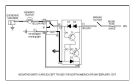
These are the details of the MkII version. For the MkI version click here, and for an 'all-electronic' version see here.

It may be my age but from time to time I find that I move from 3rd or 4th with overdrive engaged to 1st or 2nd and forget to switch overdrive off. All is well until I change up from 2nd to 3rd, then all of a sudden the overdrive engages again, usually under conditions where it is inappropriate. This means not only do I get the mild and unexpected jolt as it engages, but another one when I manually switch it off until I need it again. This has bugged me for some time and I felt sure I could knock up (i.e. build!) a circuit to prevent it.

August 2013: Following an enquiry about fitting this circuit to a car with the gear lever driver's switch I realised there are a couple of complications. For UK cars it is one of accessibility in that the circuit is inserted between the driver's switch and the gearbox switch, so you have to access those wires under the tunnel. North American cars are even more complicated, see here.

The intention of the circuit is to allow overdrive to be engaged if the manual switch is operated whilst in 3rd or 4th, but to lock it out when I change to any other gear, even when I change back to 3rd or 4th, until the manual switch is turned off and on again. On cars with OD on 3rd and 4th OD remains engaged when moving between the two, unless you move the gear lever out of the 3/4 plane into the 1/2 plane and back again, which will disengage OD and lock it out. Originally I achieved this with just one relay with a single normally-closed contact, but its disadvantage is that it requires a connection to the solenoid side of the gearbox lockout switch and there is the faint possibility that a fault could leave overdrive engaged in reverse which would destroy it. This version uses some simple electronics as well as the normally-closed relay and completely eliminates that possibility.

What happens is that the normally-closed contact of the relay is wired **in series** with the gearbox and manual switches. This means that if **any** of the manual switch, the gearbox switch, or the relay contact are open overdrive is disengaged, and they all have to be closed before overdrive will engage. **Thus it is fully fail-safe - any fault in the additional circuitry can only cause the OD to either operate exactly as the factory intended, or not at all, it can never cause it to operate when it shouldn't be i.e. when reverse gear is selected.** So as long as the relay remains released the overdrive operates completely normally, but when the relay operates it prevents the overdrive engaging regardless of the state of the gearbox and manual switches. The circuit is such that if the manual switch is closed and the gearbox switch is open then the relay will operate, and will remain so until either the manual switch is opened or the ignition is switched off. Remember that whenever the relay is operated its normally closed contact is open, and this prevents the overdrive from engaging.


If you look at the diagram you will see that with the manual and gearbox switches closed and the relay released the solenoid operates in series with the two diodes, D1 and D2. Semi-conductor diodes exhibit a small volt-drop when forward-biased, and though this is not enough to affect the solenoid the voltage developed across the two in series is used to forward-bias transistor T1 via resistor R1 and so switch it on. T1 switched on ensures that transistor T2 is switched off by connecting emitter potential to its base via R2. T2 switched off means that the relay is released, so maintaining the status quo, and overdrive engaged.

If the gearbox is taken out of an overdrive gear the gearbox switch opens, the solenoid is disconnected and overdrive switches out. At the same time the current ceases to flow through diodes D1 and D2 so there is no longer any volt-drop across them. This causes transistor T1 to switch off, which allows transistor T2 to switch on via resistors R2 and R3. Transistor T2 operates the relay which puts another break in the circuit to the solenoid. D3 acts as a 'spark quench' diode to prevent high-voltage back-emfs from the relay from damaging transistor T2 when it switches off and releases the relay. Even if an overdrive gear is selected again and the gearbox switch closes, the relay contact ensures that the solenoid is not energised, so there is still no current flow through diodes D1 and D2, so again the status quo is maintained and overdrive remains switched out.

It is not until the manual switch is turned off, or the ignition is turned off, that the sequencer relay releases, because there is no longer the 12v supply via transistor T2 to keep it operated. But this also means that even when the relay releases there is no voltage supplied to the solenoid so overdrive remains switched out.

Only when the manual switch is turned on again in an overdrive gear does current flow through diodes D1 and D2, the sequencer relay contact (closed), the gearbox switch (closed) and the solenoid to switch overdrive in again.

There has been some discussion about having a warning light glowing when overdrive is engaged, but with the dash and gear lever switches there doesn't seem much point as it is easy to see and feel whether it is on or off. Less easy with the column switch, and in fact my V8 (column switch) came with a warning light courtesy of a PO. But on the roadster with the sequencer relay there have been a couple of occasions I wasn't sure if overdrive was engaged or not, even though the manual switch was on, i.e. I can't tell if the sequencer relay has operated and locked it out without turning the manual switch off and on again. So an enhancement is to have a warning light that glows only when the sequencer relay has operated i.e. overdrive is manually selected but locked out.

Electronic components: I used some 100v 1A diodes (from Lucas, believe it or not) and 50v switching PNP transistors I happened to have lying around from my Telecom days 25 years ago. The resistors used will depend on which transistors you use, but they are not critical. I think I used 1k ohms in each case selected to give minimum current but reliable operation of the circuit. I mounted the components on a small circuit board such that it could be fitted inside an old Lucas metal can 6RA relay, utilising the spades on the insulated base plate (winding and contacts removed) for its connections to the outside world. The warning light is a red (red being significantly brighter than the green and yellow examples I had in my box of bits) LED in series with a 470 ohm resistor, the pair being connected in parallel with the relay winding, so that whenever the relay is operated the LED glows. *Updated September 2010:* The relay is a 12v automotive 'changeover', 'single-pole double-throw' or 'SPDT' type (try Googling '12v SPDT auto relay') with five spade terminals - a normally open (87), a normally closed (87a) and a common (30) as well as the two winding terminals (85 and 86), check the diagram on the relay matches up with type S4 here. Note that the circuit includes a protection diode (D3), if using relay type S6 you won't need D3 but must get the relay winding terminals 85 and 86 the right way round or you will blow the transistor. Relay type S5 includes a protection **resistor**, on its own that may not be enough to protect the transistor, and may alter the parameters of the circuit so is best avoided.


Installing to the car. The electronic module together with an aftermarket relay (with 87 and 87a connections) were mounted side-by-side close to the fusebox using a handy tapped hole that already existed on my 1973 roadster. Once the two units are interconnected they just need an earth/ground connection from a tag under the fixing screw, and two wires - one to the yellow from the main harness - via an in-line fuse if you haven't already fitted one by the manual switch - and one to the yellow/red in the gearbox harness. I've never liked drilling holes in the dash for extras so positioned the led at the top of the cut-out in the dash that accommodates the steering column. With my combination of height, seat and steering wheel I can just see the LED from my normal driving position, and being recessed slightly into the cut-out it is clearly visible even in bright sunlight.

Update October 2010:


After realigning the steering and rack columns I find the warning light has moved from being just visible to just invisible, unless I keep leaning forward which is a pain, so a new position has to be found. I settle on the small gap between the end of the crash rail and the door seal, as shown here, which is conveniently near the dash-switch.

Differences in other years and markets:

- The electronics are obviously polarity sensitive and so cannot be used as-is on a positive-earth car. However it should not be beyond anyone capable of building such a circuit to come up with a suitable variant, i.e. reversing the diodes and using NPN transistors.
- MkI models use the D-type overdrive and I have not tested the circuit with this unit only the later LH-type. The D-type solenoid has a 17 amp pull-in current and a 2-amp hold in, as opposed to the 1-amp pull-in and hold-in current of the LH-type. Because diodes offer a constant volt-drop when passing a current, two diodes in series will reduce the voltage to the solenoid by twice that forward volt-drop, and hence reduce the current that will flow in the circuit. It's possible this reduced current may prevent the D-type solenoid operating. As a first check before doing anything else you can get a couple of diodes and wire them in series with the manual switch to see what happens.
- From the 1977 model year all markets had the manual switch on the gear lever. Cars other than for North America are wired as before but the yellow and yellow/red wires have to be picked up by the gearbox owing to the physical position of the manual switch.

- North America '4th gear only' cars were wired differently because the gearbox switch also controlled vacuum advance through the TCSA switch, the order of the gearbox and manual switches is reversed, and the circuit will not work as intended. See here for more information on this model.

Testing:

- With the ignition on but engine stopped and the gearlever in 1st, 2nd or reverse turn the manual switch on and off a few times. You should hear the relay click as it operates and releases with the manual switch.
- With the manual switch off, select 4th gear, then operate the manual switch. You should not hear the relay click at any time.
- Move the gear lever into 1st and you should hear the relay click once as it operates.
- Move the gear lever into and out of 4th a couple of times and you should not hear the relay clicking.
- Switch the manual switch off and you should hear the relay click once as it releases.
- On the road, get into top gear and the overdrive should engage and disengage as normal as the manual switch is turned on and off.
- With the switch on and overdrive engaged move into 2nd and note the revs (which will be higher than in 4th of course). Move the manual switch to off and there should be no change in engine revs.
- Go back into 4th and move the manual switch to off and back to on again. If the sequencer relay is doing its job there will be no increase in revs as you switch it off but there will be a decrease in revs as you turn it on again and overdrive engages.

I've used the MkII version over several hundred miles now and it works well, just a glance at the LED tells me if the sequencer relay has locked out the OD, and sometimes the LED catches my eye anyway.

Overdrive - How many were there? *Added January 2008*

An oft discussed question, opinion being it was 'not many' in North America for some reason when the cars were new, although it is considered a very desirable addition today. Why there weren't many originally I can't imagine - it is eminently suitable for the long distances common in North America, and similar technology to automatics which were very common so that shouldn't have put people off (it didn't in the UK where automatics were rare, and are still uncommon at the time of writing). Maybe buyers just didn't understand what 'Overdrive' was'. Living quite close to Gaydon and The British Motor Museum archive I considered spending some time there counting. Thinking further, I realised I didn't need to go through all the individual build records as 18V engines from August 1971 (North American spec) and November 1973 (all other markets) had different engine types according to whether OD was fitted or not, and these represent very nearly half of all production. So if there were documents showing how many engines of each type were ordered by Abingdon I could just look at those. It was only subsequently I realised that Clausager already contains this information, as the engine number types and quantities are listed in 'Original MGB'! So here they are:

Period	Market	No OD	OD	Total	Percent OD
Aug71-Nov73	Home and non-North American export	5201	22240	27441	81
Nov73-Sep74	Home and non-North American export	434	7123	7557	94
Sep74-Oct80 (OD standard for Home market from June 1976)	Home and non-North American export	813	40087	40900	98
Total Home and non-North American export		**6408**	**69450**	**75898**	**92**
Aug71-Aug72	North America	19390	2650	22040	12
Aug72-Sep74	North America	37993	6449	44442	15
Sep74-Dec74	North America	5300	1403	6703	21
Dec74-Aug75	North America	9260	1593	10853	15
Aug75-Jun76	Canada	996	313	1309	24
Jun75-Jun76	USA	14700	3408	18108	19
Jun76-Oct80	USA (not California)	50883	10324	61207	17
Jun76-Dec79	California	11958	4483	16441	27
Jun80-Oct80	Japan	0	805	805	100
Aug76-Oct80	Canada	3458	1176	4634	25
Total North American spec		**153938**	**32604**	**186542**	**17**

Note: Whilst the Home and non-North American total engine numbers tally very closely with Clausager's production figures (just 17 different) the North American total is some 5200 different, at the moment I can't see why. The year-on-year disparity ranges from there being 1139 fewer cars than engines for the 75 model year, to

there being 3072 more cars than engines for the 77 to 80 model years (which includes Japan up to Dec 79). However this does represent a disparity of less than 3%.

At 92% with overdrive for the Home and non-North American export market and only 17% for North American spec there is indeed a huge disparity. And why should Japan get 100% with OD (admittedly on a very small number) when they got the North American spec towards the end of production? Even California and Canada got a significantly higher proportion than the rest of the USA.

Update April 2008: I've just come across the following passage in 'MG by McComb' (p197): "Another special problem on the US market concerned the MGB overdrive, which had been available from early 1963 but for some time was withheld from America - where it was most needed - because it might adversely affect the already dwindling sales of the big Austin-Healey. Eventually commonsense prevailed ...". There is no indication of how long this withholding lasted or when overdrives started to be supplied, but with the Healey 3000 finishing in 1967 the very low take-up in North America still continued to the end of production in 1980. Subsequently a USA pal said generally people there didn't know what overdrive was, so couldn't see the point of paying extra for it. It is certainly highly desirable now, with rarity resulting in very high prices so much so that it is worth shipping cheap units from the UK.