Axle/gearbox breather

Installed to Salisbury axle:

4-synch gearbox - OD and non-OD are the same:

3-synch non-OD: (Chicagoland MG Club)
However despite one being listed in the Parts Catalogue there are several indications in the wild that 3-synch OD don’t have one, just a hole in the side of the remote change unit:

Then again this does seem to have something fitted in that hole (yellow arrow, ignore red circles):
Cap removed. The cap seals the end of the tube, and the holes in the sides (one each side) allow for the breathing. Martin Roberts pointed out that they can be used with a small screwdriver or thin bar through the holes to fit it - or to remove one that hasn't already broken off. The cap should shroud the holes to hopefully prevent flood water going in, but it's a bit hit and miss. (Dave O'Neil on MG-Cars.net). I suspect this is the earlier breather as a new 21H6060 in 2017 is quite different:

A new 12H6060/V8 breather, comprising a body (A), insert (B), and cap (C). It can be seen that the main part of the body and hence the cap are significantly bigger than the original items above:
Whilst the body has indentations (arrowed), they are not pierced as in the earlier breather. Together with the cut-outs in the ring around the body (which the cap snaps onto), they allow air to pass between the cap and the body:

The insert. The small hole visible in the first image is actually too small to allow water that might be sitting in the insert to run through to the axle. Of course, if the axle is hot, and has run through water, any sitting there will be sucked in as the axle cools. The slots across the top allow air to pass between the insert and the cap:

The insert fitted to the body ...
... and the cap fitted:

Overdrive Replacement

A lot of worrying crud, probably friction material, on top of the filter, which is what led to the replacement of the OD
Gearbox separated from engine, bit of wood wedged between ring-gear and starter pinion prior to undoing the clutch cover plate bolts to replace the clutch at the same time.

Gearbox on Workmate preparatory to fitting OD
OD pump cam and splines on gearbox output shaft. Just like the gearbox first-motion shaft and crankshaft there is a pilot bearing in the OD for this shaft as well.

OD pump with cord to pull it back so the roller goes over the cam
Splines just visible inside the OD

Jacking up the OD to enable fitting washers and nuts to two of the studs
OD fitted, time for a celebratory bacon sarnie!

Arrowed is the flat on the casing that allows the removal of the V8 propshaft bolts while the flange is still fitted to the output shaft. Not possible with this 4-cylinder flange, which is smaller.
The socket in the gearbox for the remote change ...

... and the split bush on the ball in the tower, which is identical to the bush on the bottom of the gear lever
The disposition of the bottom two bell-housing bolts and exhaust mounting bracket 

Back together, gearbox harness fitted, ready for reinstallation. Incidentally I believe now that the gearbox harness should go under the remote control extension, not above it.
Rear Seal Replacement

New flange and seal, together with a wooden ring originally intended to be used to drift the new seal into position but not used.

The seal fitted over the flange
The 'tool' used to hold the drive flange steady while the central nut was undone - a piece of 2 ½” angle iron, with a curved section cut out and 2 holes. The flange nut is 1 1/8” AF, same as the front hub nuts.
Prop-shaft removed
Flange removed

The 'ice pick', and the large socket that was used to drift the new seal into position
ZS180 Cambelt Change

The components around which the auxiliary belt travels: A - crankshaft pulley; B - air-con pump; C - location of idler pulley; D - location of power steering pup; E - location of alternator; F - auxiliary belt tensioner. Sundry engine mount components have to be removed before you can remove the auxiliary belt, then crank pulley, idler pulley, air-con pump, tensioner and dipstick tube before you can remove the front cover to access the primary belt.

The primary belt: A - crank pulley; B - idler pulley; C - front bank inlet camshaft; D - water pump; E - rear bank inlet camshaft; F - tensioner.
The forked tool. About 8” cut off the flat strip and a set of 10mm (shank) bolts and nuts for the pivot and ‘pegs’ to engage with the slots in the sprocket. After the other pieces had been cut off the tool ended up being about 2 ft long overall.

Flywheel locking pin cut down from a 10mm (shank) bolt. I put the threaded end in a drill chuck, then used that as a kind of lathe to ‘turn down’ 36mm from the head to 9.7mm, then a further 12mm to 7.4mm, then cut off after that. That was before I butchered it trying to get it into the wrong hole!
Note the bolts are screwed into the fixed and pivoting arms by different amounts so they engage the cut-outs in the sprocket equally.

The curious sump washer with the rubber insert. Looking in Halfords for solid aluminium ones I noticed this type specified for Ford (yuk).

Orientation of the tension rubber cover. This is held beside the position it fits in the lower rear part of the front cover.
One of two unnecessary tools. Haynes calls for a tapered pin to help locate the sprocket over the hole to enable insertion of the bolt. This seems to be based on the two tapered pins used in the pukka MG Rover kit when both sprockets are removed and slid back on as an assembly with the belt. I couldn't see how that would help with the Haynes method, so made this pin which is actually eccentric rather than tapered, so that as the bolt was turned it would move the sprocket outwards and so locate it over its keyway. Not required, the bolt fitted right in, then turning it pulled the exhaust sprocket back into alignment and tightening the inlet bolt simply pulled it onto its keyway.

The other unnecessary 'flat bar tool' made from a few inches of offcut from a 1 metre length of 20mm x 4mm flat bar, with another 48mm length welded crosswise. In the event it wasn't needed, it kept slipping out of the shallow notches in the end of the sprocket. It might have been of more use if the crosswise piece were T-shaped to fit inside the sprocket as well as engage the slots.
Homemade degree-wheel. What more could anyone want for a one-off job?

One of the three front inlet manifold sealing rings, showing the tab that can be lifted up by a finger nail to remove the old one, and the ribs that have to be compressed slightly with the back of a finger-nail to insert the new.

Gear Lever Gaiter

Showing how much the gaiter has to slide down the shaft in 4th compared to neutral in the 1/2 plane.
Showing the additional offset towards the driver of Vee's gearbox compared to Bee, which exacerbates the problem with the gaiter.
Anti-rattle bush, with the slit arrowed

An original bush on the left with a significant chamfer to aid insertion into the remote control lever, once the bush has been fitted to the ball-end of the cabin lever. The one on the right is a replacement with virtually no chamfer and was impossible to fit, until I cut more of a chamfer.
Locating pins and damper on a 4-synch

4-synch gear lever with a rearwards kink ...
... but no sideways kink

Orientation of lever seating plate 22B524 on a 4-synch
1977 and later manual switch on the gear knob ([Upgrades4MGs and WorthPoint](https://www.upgrades4mg.com) and [WorthPoint](https://www.worthpoint.com))
Lever with thickened section, said to be a harmonic damper, but there are still complaints that this knob buzzes:

The retaining plate DAM2576 for the above lever:
V8 Gearbox Removal

Vee's gearbox started whining about a year after it was out for an engine rebuild and repaint - very annoying, as both have to come out again. It's usually said that the two have to come out together, which is simply not possible at home with a folding hoist, and I really really don't want to send her away again after the last time. With a double-length garage and Bee out of the way there is the length to work on the car and just shut the door on it at night. That would mean leaving Bee out for several days in winter weather, but fortunately pal Dave is in the process of remodelling a property so it's not occupied, and I can put her in that garage. The first dry day for weeks as I don't want to put her away wet sees Bee round there, and next day I can start. Also the start of a spell of cold weather with morning frosts, but there we are, just a matter of 'the right clothing'.

So my preferred method is to remove the engine first, then the gearbox, which would be my choice on the 4-cylinder as well. Not a trivial task in any event, but there are several aspects of the V8 which make it trickier:

- The bell-housing bolts sit further back on the V8 than they do on the 4-cylinder and are in the tunnel.
- But more significantly they are bolts that screw into the V8 block, instead of bolts through the 4-cylinder engine back-plate with nuts that are effectively in the engine bay, so you have no option but to undo the bolts. With the 4-cylinder you undo the nuts just holding the bolts still, so they don't need any 'swing' space for a spanner.
- With the 4-cylinder the bell-housing bolts are distributed fairly evenly around it, with the two lowest ones right at the bottom so easy to access. These are the last ones you undo (and the first to refit), as when the engine is hanging on the hoist and the tail of the gearbox is on one of the cross-members, the top of the back-plate and bell-housing are being pushed together, and the bottom is trying to pull apart. Once all the others have been taken out with the engine lowered, it is lifted until the gearbox is at the top of the tunnel. Then the gearbox is supported taking equal weight, the final two nuts - right at the bottom - are removed and the engine pulled forwards. That's the 4-cylinder! On the V8 all of them are round the upper half of the bell-housing and inside the tunnel (blue arrows below taken prior to reuniting engine and gearbox on the workshop floor after the engine rebuild), so the lowest two are up inside the tunnel even when the engine fully lowered, even higher when the engine and gearbox have been lifted to the top of the tunnel. The top two are right on top and not visible from underneath, and only just visible from above, at an angle inside the tunnel, with no space to fit even an angled ring spanner let alone swing it.
- Whereas with the 4-cylinder several bolts are left in the bell-housing to act as guide pins when pulling the engine forwards and refitting, but on the V8 as soon as the threads are disengaged there are just a couple of short dowels (green arrows) for location, so you have to be sure the gearbox and engine are supported equally as those dowels disengage, so you don't stress the first-motion shaft. As it is, I'll have to partially unscrew the two lowest ones, ease the engine forwards to disengage the dowels, and the bolts will still be keeping the two more or less in line. If those have now become stiff to turn, I'll know the engine and gearbox are not supported equally, so can make small adjustments to one or the other until the bolts turn freely - that's the theory at any rate!
However looking ahead to getting the gearbox looked at, one of my contacts came up with a local chap, and he said it is possible to get the V8 engine out on its own. You have to remove the engine mounts and mounting plates, and exhaust manifolds, and that allows the engine to sit a good 2” or more lower in the chassis. Then with the carb assembly off and heater hoses and heat valve out of the way you have more access to the top two bell-housing bolts. To get the off-side exhaust manifold off the rack needs to be removed, and removing the manifolds gives more access to the engine mounts, so quite a bit of work needs to be done to get to the point where you know you will be able to access all the bell-housing bolts. The engine has to be lifted right up so the mount studs are clear of the chassis slots so they and the mounting plates can be removed, so prior to that I disconnected the oil cooler and gauge hoses to avoid stressing them, removed the distributor cap and leads and fitted an old cap to protect the distributor innards. As I can only borrow the hoist for the final extraction I'm having to raise the engine by jacking under the sump with a wood block, and squeezing in and out between that and the wheel ramps first one side then the other is hard work. With the mounts and plate off and the engine lowered onto the chassis rails, and the carb assembly removed, there is a lot more access to the top two bolts as shown below, even though in this picture the engine is sitting on thin wood blocks in place of the mounts and is not quite as low as it can go.

However as there is so much work involved to get this far it would be advisable to check you can move the six lower bell-
housing bolts first - slackening each then nipping back up. If you can't then there seems little point proceeding, and if you intend driving the car elsewhere to get the job done make sure any you have been able to move are retightened fully. If you can't get a socket on any of the bolts with a 3/8" drive, multiple extensions, U/J and socket try dropping the rear cross-member which will allow you to swing the tail of the gearbox an inch or so either way, which may give just enough clearance to the tunnel. Even then there is no guarantee that you will be able to move the top two.

Having got access, the next question is will they undo! Joined together with both units on the workshop floor two years ago, and tightened with a 1/2" drive socket wrench, no torque I'm aware of. Even with the extra space it's not enough to get even my 3/8" drive socket wrench in there, let alone with a U/J, and especially not my 1/2" drive, a swivel head type might. I did lay in a 1/2" and 9/16" swivel-ended socket spanner, which did just go on, but is very close to the tunnel. My angled ring spanner went on easily, with the handle pointing out at a convenient angle. But it's shorter than the swivel ended let alone the socket wrench, and I couldn't get enough force on it to shift the nut. So get one of my oil cooler hose spanners, put the ring on that over the appropriate half of the open-ended jaw to get more than double the force ... the spanner was bending ... there was a 'crack' ... and the bolt was free. Ditto the second top bolt - phew! That took about four hours and enough for one day.

The big question for the second half-day was, would the remaining six come undone! Underneath it looks like there is enough space to do one side but not the other, which is right up against the tunnel wall. Nevertheless I get my 1/2" drive socket with long and medium extensions and a U/J, and by leaning the wrench head against convenient chassis rail and cross-member they do come undo with the same 'crack'. I don't intend to disconnect the gearbox cross-member from the chassis rails until the last minute, which is giving a degree of stability to the engine as it's going up and down and only supported under the sump. The only way I can get access to the other side is by jacking up the engine and putting a chunk of wood where the engine mount goes on the side I want to access, so when I jack it down the engine is forced across to the other side ... and those three come free just the same. So that's all eight loosened now, and I have good chance of being able to complete the job. It's only now that I start thinking about everything else that has to come off - drain coolant, remove radiator hoses, remove fan guard, radiator, cooling fans (the fan comes off the motor replaces many years ago but I have to remove the other motor complete with fan), alternator, temp gauge sender, servo hose, coil to distributor wire, and anything else round the top of the engine, and enough for another half-day.

The next half-day was removal of centre cubby and armrest, gear lever, starter, clutch slave from bell-housing left hanging on hose, prop-shaft, speedo cable, and anything else round the gearbox such as disconnecting the gearbox sub-harness from the main harness at the heater shelf. I'd been pondering lowering the gearbox cross-member to give better access to the bell-housing bolts and more tilt on the engine, but didn't want to leave it completely disconnected. I found some long bolts that fitted the chassis rails, and used one each side in place of the four short originals. I had to remove Bee's chrome bumper when getting her engine out with this hoist, so felt I'd have to do the same with the rubber bumper. I didn't want to wait until I got the hoist as I want to crack straight on getting the engine out, so decided to take it off anyway, which meant removal of the mesh grille so I could disconnect the indicator wires from the main harness. I may have to remove the front valance as it is the ST 'scoop' type and projects forward slightly rather than simply curving back, but that can wait as I'll still have the morning before we tackle the extraction in the afternoon. That really is about all I can do, the bonnet has to come off but will wait until Dave comes round to help with the final extraction, but I can prepare by removing the rear hinge-to-bonnet bolts and slacken the front ones with plenty of padding under the rear corners and the front (as recommended by John Maguire) and disconnect the prop, so all that needs to be done is remove the front hinge-to-bonnet bolts and lift it off.

21 December 2019
I left the gearbox draining over night into a clean bucket, nothing in there next day, but some metal fragments in the hollow in the drain plug. Otherwise a day of rest, apart from constructing a support for the rear of the engine as that will have to go back minus the gearbox, which will then allow the car to be pushed back onto the full-length ramps so I can get Bee back from her temporary home. Hoist arrives that night.

Should be the big day, but Dave isn't available until 2pm which gives me the morning to ponder attaching the hoist and thinking through all the steps needed. I decide to remove the valance rather than risk damaging it, and it gives an extra inch clearance between car and hoist as well as giving me more room to slide under and back out, should have done that at the outset.

Restricted for height in the garage, especially as the car is on wheel ramps, so I set up the hoist and leveller chains for minimum length. Not ideal as the leveller is shorter than the distance between the V8 lifting eyes, which means the chains will be at an angle and tending to pull the eyes towards each other, and towards the rocker covers. Last time putting engine and gearbox in together we used a strap through the eyes to the hook on the hoist, no leveller, and both eyes did end up bent, but how much of that was new and how much old I don’t know. The strap was left longish, maybe about the same angle as the chains will be, so we’ll see. That leaves the leveller quite close to the long carb plenum studs sticking up from the inlet manifold, so they come...
The rear attachment point is very close to the heater motor, to that comes out with its fan, and I dig out a couple of stout bolts with nuts, and big washers, to attach the leveller chains to the V8 lifting brackets. The heads of the bolts are very close to the rocker covers, so I remove the screws but leave them sitting there as a loose cover.

Then I have to think about getting underneath to remove the remaining bell-housing bolts with the hoist in position, and really I don't think I'll be able to lie across those while getting underneath, and especially getting out again. When I did Bee's clutch I got in from the sides behind the front wheels. But the wheel ramps are only a few inches away from the end of the full-length ramps and not enough room. So I jack the one wheel up off the ramp and turn the ramp round, and take off the mud-flap, but still not enough room. Nothing for it but to jack the front wheels down to the floor and roll it forward a foot or so ... which needs the rack to be refitted loosely, but it would need to be anyway to roll the car back onto the full-length ramps after engine and gearbox are out, so no big deal. Then jack back up and slide the wheel ramps under, facing the 'wrong' way as before to give me the maximum space from the sides. Finally I have plenty of room to get in from the side, but with the trolley jack in place as it will be to support the gearbox I can't reach across to the other side. So the mud-flap comes off that side as well. Really the front of the exhaust pipe is in the way as well, so round the back and completely remove the rear mount (only slackened before along with the centre mount), and I can pull the exhaust system back until the centre box reaches the centre mount. As well as being largely out of the way now, it also allows me to pivot it round so the front end is by the sill and not the tunnel.

Next morning I hook up the hoist with leveller, but I'm still concerned about being able to lift the engine high enough to clear the slam panel before the end of the jib hits the ceiling, especially as the body will rise a couple of inches as the weight is taken off! With the engine pulled forwards clear of the gearbox I may need to lower the gearbox trolley jack, then jack the body to replace the wheel ramps with axle stands ... which needs two jacks ... and fortunately Dave has one as well. If we slide the gearbox out from under the car the body may have to go back on the wheel ramps again, plus be raised a bit more, as from measurements the space between the front cross-member to the floor for the height of the bell-housing is also going to be close, even though the body will be a couple of inches higher without the engine. Alternatively we could lift the gearbox out after the engine. Dave arrives in the afternoon so I start removing the side bolts between the bell-housing and the engine, leaving just the bottom two in place. Three come out no problem with fingers after a turn or two with the ratchet handle, but the fourth needs ratcheting all the way and comes out so far and no more. I think it is clear of the thread in the engine, so wedge a long screwdriver behind the head while I ratchet some more, which gets it out another half inch so must be clear. Then start jacking to raise the top of the bell-housing to the top of the tunnel ready to support the gearbox and remove the final two bolts ... and the hoist starts sinking! There is a small Mole wrench on the release valve instead of using the slot in the end of the jack handle, which involves lying the hoist on its back each time, but despite doing that repeatedly, when we stand it up again it still hasn't reached the bottom of the filler hole. Thinking if lack of fluid was the problem, having added a significant amount it must have made a difference. But no, once it starts sinking it does so until the engine is right back on the chassis mounts. Also before hooking it up to the engine I jogged the jib right up to the ceiling to check the clearance for the engine to the slam panel, and it didn't sink then. No way we can risk it, if it suddenly drops half way out it would all be over. Bugger bugger bugger.

Dave leaves to call on a couple of places that might have a hoist and hits pay-dirt at the first - same type as this one so we know it will fit between the ramps. Next morning he brings it round, and the other chap collects the first hoist saying when he asked the person who had it before about it sinking he said "Oh yes, I just keep cranking ...".
The first job is to clear as much space at the front of the car as possible which we should have done the previous day really. Hook up the new hoist with Dave suggesting we use the shackles through the lifting eyes on the engine instead of the lifting plates with bolts i.e. fit the chains the other way up, and that gives loads more clearance to both the rocker covers and the heater motor had it still been there - the power of lateral thinking. Raise the engine and gearbox ... and hoorah, no sinking! But the bolt that is stuck in the bell-housing is jamming on the side of the tunnel, so ponder a bit, can see it from above with them lowered, so get a long screwdriver in as a drift behind the head, tap it with a hammer, and out it pops. Now the engine can be raised until the gearbox is at the top of the tunnel, and I can see the sump will clear the cross-member with a straight pull forwards, unlike the CB 4-cylinder where it has to be angled once the first-motion shaft is clear of the clutch splines before it can be pulled forwards any more. Now with a trolley jack under the front of the bell-housing I can start slackening the two lowest bell-housing bolts.

One mistake was using the minimum length of chain being concerned about the headroom to get the engine over the slam panel, and we found the we couldn't turn the leveller handle as it was too close to the engine. But I'd set that before hooking it up testing the 'twang' on each note by tapping them with a spanner gave the same sound so I was confident the engine would be at the right angle when it started to come free, and not stress the first-motion shaft or anything else. I undo the bottom two bell-housing bolts bit by bit, but can't get any separation top or bottom. So with a bit of wood against the bulkhead I put a breaker bar behind the top of the engine and the gap opens up a couple of mm. Underneath and no movement, so raise the engine a little, then Dave waggles the front of the engine from side to side - and Bingo movement at the bottom as well. So now it is a case of slackening the bolts bit by bit, pulling and waggling, checking that the gap opens up evenly all round. Then when they are about an inch apart there is a joggle and they are free! Now it's just a case of pulling the engine forwards so it is fully clear of the 1st motion shaft, and raising it to clear the slam panel. Part way up I measure the height from the top of the jib to the bottom of the sump, and compare that with the distance between the ceiling and the slam panel, and we have about 30cm spare, so that's one problem avoided and no need to lower the car, and I could have used another couple of links on the chains and been able to swing the leveller handle - must remember to do that for the refit. Hoist it the rest of the way up, pull it completely forwards, and swing it round to park it on a Workmate. Now for the gearbox - hoist chains attached to the bell-housing in preparation for the initial pull forwards to bring the OD clear of the fixed cross-member before lowering it, as with the rear cross-member disconnected I didn't want to risk it toppling off the trolley jack.

I'm deliberately leaving the gearbox cross-member on the gearbox to stop it rolling. Took the weight of the bell-housing on the hoist, got a trolley jack under the removable cross-member to lift the OD off the fixed cross-member and remove the temporary bolts though to the chassis rails ... but all that happened was that the bell-housing rose up in the air! All the weight is at the back of the gearbox, so that trolley jack has to go under the end of the OD, and I can remove the chassis rail bolts. Pull the gearbox towards the front cross-member clear of the fixed cross-member, and lower both the hoist and the trolley jack onto a plank so we can drag it forwards on that rather than the painted concrete floor. We are couple of inches short for clearance under the front cross-member, but jacking under one of the spring pans raises the car enough to pull it out ... and it's free! After the engine, this bit was really easy.
Stand the gearbox on wood blocks to keep the first-motion shaft clear of the floor, ready to remove the cross-member and mounts, sub-harness, reverse light switch. I decide to remove the tower as well to investigate the OD switch actuation mechanism further, with a view to converting it to 3rd and 4th to overcome the coming out of OD on the over-run. Drain the gearbox first while in-situ, then after standing like this for a while lay it level and drain it again, and about another pint comes out:

I remove the nuts from the mount studs going through the cross-member which is much easier without there being a car above it in the way, but without the gearbox being held firmly in the body it makes it harder to pull the cross-member off the studs - not helped by forgetting to remove the two bolts that go up into the central bracket! So I opt to remove the bolts that go into the gearbox itself from one of the rubber mounts, then it can be lifted off the other mount stud:
When dismantling bear in mind that there are up to 32 different ways the crossmember components can be installed!

I’d been advised not to replace the mount rubbers unless absolutely necessary as new ones are so much harder, but these are definitely perished even having gone shiny and ‘melted’ in one area, so I will replace them. The central bracket circular rubbers can stay as there is no sign of damage and they only restrain the gearbox against excessive forward movement in the event of a severe frontal impact:

The gearbox harness (on the V8) has a clip on the upper right bell-housing bolt, and another on one of the gearbox to bell-housing bolts by the reverse light switch. The harness is really hard and inflexible, with the wrapping tape damaged in several places, but more importantly the insulation is cracked on a couple of the wires near the terminations, so that will have to be replaced. The 4-synch OD and reverse light gearbox harness AHC258 in the Parts Catalogue specifically states ‘Not V8’ but there is not another one shown. The V8 harness can be shorter as it only has to reach as far as the shelf under the heater motor, as the three wires involved are part of the tail leading to the heater motor and screen washer. The 4-cylinder version is longer as it has to reach the mass of connectors in the main and rear harnesses, but I suppose I’ll have to use that one. MGOC and Leacy use part number AHC258, but Brown & Gammons uses ‘684’, and Moss ‘BL654’. Another purchase will be the release arm gaiter 22B450 as when removing the arm and cleaning it up the gaiter was virtually in three pieces:
The pivot pin is also showing wear but as the hydraulics compensate for all mechanical wear at that end of the system that can stay:

The release bearing is interesting. Although it is a bearing-type and the face that contacts the cover-plate rotates with it, there is a noticeable flat worn on that face (left), whereas the new one on the right is rounded and matt:
In the fullness of time after the gearbox has gone to the workshop (on 10th December) we will put the engine back in the car, with a support for the rear, push it back all the way onto the full-length ramps, so Bee can come back home. But in the meantime I extend the heat insulation on the inner wings. The original sections were working perfectly well, but as the manifolds extended back further it didn't look right.

Reverse Idler Gear

To engage each gear the gear selector fork moves one of the pink dog-clutches into engagement with one of the blue output gears, to lock it to the output shaft and provide drive through to the prop-shaft.

The additional purple idler gear between the red layshaft and the blue reverse output gear reverses the direction of rotation of the output shaft when in reverse.

An oddity with this drawing is that despite each successive forward gear being larger on the lay shaft and smaller on the output shaft as one would expect, the lay shaft reverse gear is only very slightly smaller than the output gear size. This would give about a ratio close to 1:1 i.e. 4th gear, but in practice reverse is usually a higher ratio than first - 4.76:1 for reverse on the MGB and 3.64:1 for 1st gear. This means that in practical terms reverse gear on the output shaft is similar in size to first and the layshaft gear is slightly smaller than first, leaving a gap, which is filled by the reverse idler gear.
Interlock Arm Assembly

The 3-sync assembly being removed (Haynes) ... 

... and the 4-synch in-situ
Having acquired a 4 speed non o/d gearbox, I was able to dismantle it. It was purely for interest and to "see how it works". It turned out to be in excellent condition, so I did not remove the various components from the shafts. The key difference between this and an o/d box is the mainshaft, plus a few bits and pieces. O/D mainshafts are NLA (as are some parts) so it may prove more economical to source a recon box.

The workshop manual and Haynes are fairly good, but the following may help also. The "books" also give information as to clearances and checking for wear.

You will need to remove the "big nut" at the end on the mainshaft. It is probably worth doing this right at the start.

You need a piece of 6mm angle iron, about 2 foot long, with a suitable sized "bite" out of one end and two holes. The bite is large enough to fit the 1 5/16" AF socket and the holes line up with 2 adjacent bolts on the flange. I was lucky in that when bolted up, the angle iron rested against the leg of the bench, so I tied it to the leg and used a 2 ft breaker bar to undo the nut. It might be easier to leave the gearbox on the floor to allow it's own weight to help with undoing the nut.
(See also this 'universal' tool made from B&Q flat steel strip).

Gearbox input shaft - release bearing inadvertently rotated through 180 degrees.

Front plate removed.
Note orientation of cut out on layshaft. Check for shims either in the cover or stuck to the outer bearing face.

Check for shims in front plate.

Check for shims

What lies inside.
I found removing the interlock plate impossible until I moved the gear selector lever out of the way by selecting third (I think) gear. It's a fiddle and perseverance is needed! I used a socket on the end of an extension as a makeshift gear stick located in the hole. The plastic grommet had remained in place on the remote control shaft.

You now have the gearbox in a more manageable state-without the remote cover and the tail-just the mainshaft sticking out.
Remove the selector rods and forks as described in Haynes. Check the clearances for the laygears.

Reverse gear and shaft removed.

Next to drift the layshaft out. You need a long drift and a piece of coat-hanger wire. As you drift out the shaft push the wire (not shown) down the centre to keep the thrust washers roughly in place. Allow/assist the laygears to move to the bottom of the casing.
I managed to remove the mainshaft whilst the box was horizontal—it slid out easily—note the cut-out in the bearing housing. It might be necessary to put the box bellhousing on the floor (on blocks) and tap the rear of the casing to free the mainshaft. In this case ensure the laygears are out of the way, as being vertical, they can move across and jam the mainshaft. Inspect the mainshaft clearances.

Take care not to damage the plastic speedo gear.
More shims on the mainshaft.

The plastic speedo drive. If it shears you have to remove the whole gearbox...

Shims!

To remove the input shaft you need to use a (softish) drift on the outer bearing face from inside the box. It takes time and patience as the angle is not easy!
It's now apart!

To re-assemble......I put the box on blocks on the floor to drift the input shaft assembly back in. Again a softish drift is called for but as it refused to go in, I finally resorted to a 4 ft long steel bar and the wheel spinner hammer, but keep it on the outer bearing casing. Just tap round and round till it goes in! Check the needle roller bearing is either on the mainshaft or the inner end of the input shaft-doubtful! Rest the bell-housing end on blocks on the floor and ease the mainshaft in (note cut-out in bearing housing). It will need jiggling as 2 sets of splines must engage. An assistant is useful in ensuring the laygears are kept out of the way. Once the mainshaft is in, move the laygear assembly till in "engages", find a piece of 20mm electrical conduit or similar, and insert this over the coat-hanger wire to reposition the laygears and thrust washers more centrally. Replace on the bench. Clean the layshaft and check for any burrs or damage. Attach a bungee cord or rubber bands to the end of the electrical conduit at the tail, sufficient for it to be taut enough to keep the end of the conduit against the end of the shaft as it is drifted in. Alternatively an assistant can keep pressure on the tube. Drift the layshaft in from the bell-housing end taking care that the orientation of the cut-out matches that of the front cover (you can use mole grips to rotate it once it is inserted).
Squirt some oil on to the cogs and up the oilway on the ends of the layshaft, and twiddle the input shaft.

Slide the selector rods in through the forks. Note that the rods have holes in which the bolts bolt into. A delicate touch whilst finger tightening these bolts and moving the rod very slightly will ensure the bolts are in the right place. I got it wrong and caused the "fingers" (that protrude out of the tail) to jam.

Once I rotated the shaft a tad the bolt in the fork engaged properly and the "fingers" slid past each other. Now slide the tail on having first replaced the gasket, and bolt up. Engage 3rd (I think) gear to allow the interlock to be inserted. Feed it in rounded
end (not the finger end) first as far as possible in a diagonal direction. Then rotate it and move it slightly left to allow the flat plate to sit in the recesses. Again a fiddle-at first it seems impossible and when it finally slips in, you wonder how you did it! Bolt the remote casing back on, squirt some oil on the cogs, bearings, and replace the side, and front covers. I was storing mine so just used enough to keep moisture at bay. If replacing in the car I would add more to allow for initial lubrication.

Gearbox and Rear Axle Oils

Castrol V8 gearbox oil showing ‘MANUAL’ and a picture of a gear lever on the front ...

... and ‘MANUAL’ and ‘GL4’ on the back.

Castrol rear axle (and steering rack) oil for all MGBs showing 'DIFFERENTIAL' and a picture of an axle on the front ...
Replacing gear box mounts-by removing the Cross-member
by Michael Beswick

Removing the gear box cross-member is reckoned to be one of the most tiresome jobs on a B! But there again there are lots of most tiresome jobs!

At first glance it may seem that the 4 bolts holding the mounts to the gearbox could be removed. Subsequent removal of the 4 cross member bolts would allow the cross-member to be lowered (supporting the gear box) complete with the “yoke” fittings. However at least 2 bolts through the mounts into the gearbox are inaccessible and all may suffer from the rubber mounting pad expanding and covering the bolt heads.
According to John Twist’s video there are 16 different ways for the assembly to be fitted! (November 2014: Now doubled to 32!) Whether due to incorrect fitting or not, most people have difficulty removing the cross-member! This is my experience / suggestions! Take particular care to mark which way round the bits go......

Mine is a 4 synchro box with overdrive on a 69/70 chassis.

To start, it is worth printing off the Moss parts diagram as it illustrates the all bits and some of the angles of fitment. The Leyland 4-cylinder and Haynes Manuals and the Parts Catalogues drawings are variously incomplete and/or misleading in respect of what parts are present, the order and the orientation. However the Leyland V8 Supplement also has a good drawing showing the assembly, additionally with the detail of the bush location in the yokes.

First, try to loosen the 4 main (9/16 AF) bolts that hold the cross-member to the chassis, and the 2 central ones (1/2” AF) that hold the lower yoke to the cross-member. If your gearbox is anything like mine, it leaks, so all the adjacent nuts and bolts are unlikely to be rusty. Cross-member mounting bolts are another story and are mounted to captive nuts (or maybe a threaded plate) in the chassis rail. If it is a plate, this may move, so avoid raising or lowering the car if possible –or loosely fit a bolt in each side.

Assuming the bolts move, mark the position of the cross-member on the chassis rails and nip them up again.

Looking at the parts diagram, note the angled brackets that take the mounts can have 2 holes in them. As the cross-member comes away leaving the mounts (and yokes) attached to the gear box, note which hole the mount was fitted to. Witness marks should show this. For which years had which parts see here. It is worth bearing in mind that after 40 years (more or less) any car could have any combination of gearbox, cross-member and mounting parts, and there could be more than one combination that lines up depending on which way each part is orientated. For example John Twist states that standard gearboxes use the front hole and overdrive the rear, but this assembly was found with an overdrive gearbox using the front holes. The bottom line is that the datum must be the engine attached to its mounts, then the cross-member parts orientated to put minimum stress on the gearbox rubbers when bolted up.

Measure and mark a point 100mm from the centre of the bolts that hold the yoke to the cross-member outwards. Drill respective pilot holes. The exhaust starts to get in the way on the left-hand side.

On the right-hand side enlarge the hole to 10mm, and then elongate it to about 18mm. The 18mm dimension is “across” the car, the 10mm front to back of the car.
Repeat for the left-hand side but enlarge to about 22mm “across” and 18mm front to back. This is not critical—the cross-member is strong, so you could just make bigger round holes. I used a Dremel to enlarge them.
It should be possible using a 250mm ¼" extension and a ½" socket to reach the nut on the rubber mount on the right-hand side. Fit the socket after you have fed the extension bar through the hole. Note that rubber bumper cars and all V8s should have an earthing strap round the right-hand mount.
If the nut won’t shift or you only have a 3/8” drive set-make the hole bigger. For the left-hand side, the socket fits on to a 75mm extension, then a universal joint, then a 150mm extension. This allows you to work inboard of the exhaust pipe. The whole lot does move about a bit, as the U/J is turning in the hole that you drilled.
Alternatively remove the exhaust, so it becomes a repeat of the right-hand side.

And all this for two $\frac{1}{2}''$ nuts........(Note washer and spring washer each side) Have a break-you’ve earned it!

Support the gear box back end. If O/D style, blocks of wood allow you to rest the tail of the O/D on the fixed cross-member. I lifted the tail slightly to compensate for the collapsed mounts. Remember that the whole engine is now tilting slightly, so for c/b cars the clearance between front crankshaft pulley and steering rack could (but shouldn’t) become an issue. (Mine is 10mm clearance)
Remove the 2 bolts that hold the yokes to the cross-member. Remove the 4 bolts holding the cross-member to the chassis. It should now move, though probably will not drop away, as the studs on the rubber mounts are still through the angled shoulders of the cross-member. Look at the parts diagram: as this hole is not elongated the cross-member cannot be freed. You will need to lever one side or the other to free the bolt one side. There should be some “play” as the rubber mounts are almost certainly squishy! Now it will come away. Note which way round the lower yoke is mounted (it rotates fairly easily) to aid re-assembly. The captive nuts in this lower yoke are mounted off centre...
You should now have the cross-member free and the rubber mounts, upper and lower yokes bolted to the gearbox. The rubber mounts almost certainly have “spread” preventing easy access to the bolt heads. Cut away the excess rubber! Remove the two bolts on either side and remove the upper and lower yokes (bolted together) and the two rubber mounts.

Note which way round everything goes again!

To dismantle the yokes, use a mole grip on the top “disc” to allow removal of the nut and washer at the bottom. With so much apart it is pointless not to renew the rubber “bobbins” that are a feature of the two yokes. These are a pig! I reduced the diameter of the smaller of the two “discs” from 32mm to 28 mm using a belt sander whilst rotating the bobbin. The technique is to heat the bobbins, and use Vaseline on both it, and the metal yoke. Put the yoke in a vice, and put a loop of nylon cord around the waist of the bobbin (check which way up they go – see parts diagram) with the ends passed through the hole in the metal yoke. Pull downwards so the lower edge of the smaller diameter “disc” of the bobbin goes through the hole and use a blunt pusher (6mm punch) to push the rest in – working round the disc. Note that it makes sense for the narrower diameter of each bush to be pushed through from the side that doesn’t have the lip round the edge of the hole.
I managed to snap two across the middle—perhaps they were faulty......

Clean up the captive nuts in the bottom yoke and the threads on the bolts (or replace) use Coppaslip! John Twist mentions squeezing (or stretching) the lower yoke in a vice so the bolt holes in the cross-member line up with the welded nuts on the yoke. It's a good time to check and adjust this alignment now.

Having re-assembled the 2 yokes with new bobbins I was unimpressed with the amount of “slop” in the whole arrangement (see here for comments on the various engine/gearbox restraint methods over the years), especially when viewed against the effort of getting the bobbins in. However it allows more “wiggle room” during re-assembly.

Now back to the cross member. The new rubber mounts are likely to have far less give in them, so it will be more difficult to lever the cross-member on than removing it—and it has to be in the right place! Elongate the fitting holes to about 15-18mm-upwards. This should allow the cross-member to be lifted and located easily(!) on the protruding studs of first one and then the other mount. Clean the cross-member mounting bolts—or replace- and put Coppaslip on these. I also slightly enlarged the holes in the cross-member through which the bolts go to hold the lower yoke, to aid reassembly. Note John Twist's video (and also this very wordy alternative) shows one of these holes elongated so neatly that it seems 'factory', however this cross-member didn't have that.
Note the bolts holding the yokes and rubbers to the gearbox are UNC. Clean the threads. The corresponding drillings in the box casing are probably clean, but worth running a new bolt (or a tap) to check. Again I Coppaslipped the lot!

Generally the fitting holes in the shoulder on the cross-member are front for non-o/d and back for o/d. Mine were front for o/d....The upper yoke always has the flat face pointing forward. The cross-member always has the cut out (for the earliest gear box steady bar) pointing forwards. Check the alignment of the lower yoke captive nuts and the holes in the cross-member. Using longer bolts with a filed point to aid location would be easier than refitting the short original ones, and allows for some wiggle room on re-assembly. Once the assembly was tightened (but before bolting up the cross member) I removed these long bolts one at a time and replaced with short ones. You could leave the long ones in, but the protruding thread will corrode make
Re-assembly: Now is a good time for examining faults with either the reversing light switch or the overdrive switch, and for treating the inside of the chassis box sections with Waxoyl or Dinitrol.

Re-assemble the two yokes with the pin through the two bobbins. Mount this and the rubber mounts on to the gear box. The top yoke will be firm, the lower one able to move.

November 2014: If there wasn't already enough options for assembly some suppliers now have the rectangular rubber mounts with cut-outs, meaning that whereas before they could be fitted either way round, now there is a difference in the shape of the rubber and the forces acting upon it, making them 'handed'. In the orientation as shown on the left the unsupported faces are horizontal, but as fitted on the right they are vertical. Logic dictates that vertical is correct, as the main weight of the gearbox acts vertically so the rubber will be in compression. If fitted horizontally the rubber would experience a significant shear load. It's true that when in use the forces could be in any direction, including fore and aft, but as with very few exceptions cars spend more time sitting than running, it seems that fitted as shown on the right is preferable. (Images from Graham Barker)
Wiggle the cross-member roughly into position resting up against the yoke assembly. Use the longer bolts mentioned above to lift the cross-member and take its weight. Starting on the left-hand side, waggle the cross-member on to the stud of the rubber mount. With a little squeezing lift the other side on to its corresponding stud. Tighten the bolts that hold the cross-member to the yokes just enough to prevent the cross-member dropping away—no more.

Jack up the gearbox enough to remove the packing supporting it on the fixed cross member. I left an 18mm thick block, which still allowed access for the next operation.

The angle of the studs (protruding through the supports) is downwards, making fitting washers and nuts difficult. Start with the more difficult left-hand side. Coppaslip the stud to assist with stiction. I opted for a single spring washer, and used one of those spring tools with 4 claws (operated by your thumb on a plunger) to hold the washer. There is a convenient slot through which you can offer the washer and gently press it over the stud with a finger on your other hand! Put the nut in the socket, and place the socket above the elongated hole in the cross member. Fit the short extension bar through the cross-member on to the socket and allow to hang (vertically). Fit the U/J and the longer extension bar. Use two fingers to locate the short extension/socket/nut on to the stud, whilst maintaining a little upward pressure on the long extension as you twist it. Repeat for the right-hand side where the long extension is all that is needed. Remember to refit the earthing strap on rubber bumper cars and V8s!

Snug the long bolts through the cross-member into the lower yoke. Remove one and replace with one of the correct length. Tighten this and repeat for the other long bolt. This isn’t because the standard bolts don’t fit until the bushes have been compressed, but because it is a juggling act holding the cross-member up, keeping the lower yoke at the right angle, and lining up the cross-member hole with the yoke captive nut so you can start the bolt, the longer bolts make this easier.

Jack up the gear box (not the cross-member as you may need to waggle it to fit) until the cross-member is correctly located, and refit the 4 bolts.

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Gearbox crossmember Detail

Restraint Pin
Restraint Rods

The front face has a dip, and the rear face is straight with various holes, both of which accommodate one of the two restraint rods that were used at various times. The welded nut arrowed is for the speedo cable clip when OD is fitted, and is on the off-side:
The front of the welded brackets 'B' is stepped back, and the front edge of the upper yoke 'C' is flat:
Conversely the rear of the welded brackets 'B' is flat and the rear edge of the upper yoke 'C' is stepped rearwards:

The lower restraint-pin yoke is orientated such that the welded nuts are behind the centre-line of the pin:
The mount stud goes through the front-most of the two holes in the bracket:

The upshot is that the rubbers are positioned centrally across the crossmember, and the lower yoke welded nuts line up with the holes in the crossmember:
Perished mount rubbers:

Showing the assembly of all the central restraint pin (once the crossmember has been removed!). The flat edge of the upper yoke faces forwards (9). Inset ‘10’ shows the insertion of a bush into a yoke, in this case the lower yoke with the wider diameter inside the yoke. Invert the image for the upper yoke. (Leyland V8 supplement)
Showing the earthing strap (8) on rubber bumper cars and V8s, one end under the head of a bolt securing the mount to the gearbox casing, the other under the nut on the mount stud. Shown on the right-hand side, although they could well be fitted to the left-hand side:

**Restraint Rods:** Mk 1 roadsters had a crossmember with just a single hole for each gearbox mount stud, and welded nuts on the rear face for a restraint rod bracket. A short rod passed through the crossmember and bracket and was retained by a nut. The front of the rod has a 'U'-bracket that goes around a protrusion on the bottom of the gearbox casting close to the crossmember, and a special pin goes through the bracket and protrusion with rubber bushes between them. They don't appear to have the yokes, bushes and pin at this stage.
Mk 1 GTs don't appear to have the restraint rod, but have the yokes, bushes and pin instead. Although these are not as 'positive' at restraining forward movement as the roadster rod they will limit it. They also prevent any untoward lifting of the gearbox tail should the rubber mounts part which could tip the fan into the radiator, and almost certainly would prevent them parting in the first place. Mk1 GTs also have control brackets as part of each engine mount that restricts how far the engine can move forward. Perhaps not quite so positive as a restraint rod, but just as effective as keeping the fan away from the radiator. Unfortunately if these front control brackets are left out during an engine removal and refitting the engine has no positive restraint, just the floppy (in the fore and aft direction) yokes, bushes and pin. Very few seem to exist in the wild going by past comments (although Michael's has them), but they are available from the usual suspects, part AHH7890 variously described as 'Bracket control', 'Bracket - Engine Surge', 'Recoil bracket', and 'Restraint Bracket'. The mounts that bolt to the gearbox are different to those on the roadster.

Mk 2 cars have a crossmember with two holes for each gearbox mount stud, and no welded nuts for a restraint bracket (and hence no restraint rod), although the holes are still present. The upper and lower yokes with bushes and pin are now on all cars, but are different in design to the GT originals. All GT and roadster parts are now common. The quantity of the front control brackets was reduced from 2 to 1 (penny-pinches again), for markets other than North America, for the 1972 model year. These cars would definitely benefit from retro-fitting the front control brackets if they are missing.

In Feb 74 (still chrome bumper) a new restraint rod was added to North American cars. This used a welded bracket on the front face of the crossmember, and a longer rod going all the way to a bracket that attaches to the two bottom bolts that secure the bell-housing to the engine. Other markets got this arrangement at the start of rubber bumpers, but despite this very positive restraint being used again, and the yokes, pin and bushes, the front mount control brackets were also apparently still provided (making no less than three restraint systems!), 2 for North America, 1 elsewhere as before, until the engine mounts changed from rectangular to round at the start of rubber bumper production in September 1974, which prevented the use of the front...
control brackets. The crossmember brackets now have two holes for the stud on the rubber mounts, which adds to the possible combinations of assembly.

The V8 only ever had the yokes, bushes and pin as part of the crossmember assembly, never a restraint rod or front mount control bracket.

**Gearbox/OD Oil Change**

The hollow drain plug from the roadster and some metal debris. As I recall the V8 drain plug was flat:
Roadster sump and gasket/filter, no damage to this on removal unlike the V8:

Sump and all the relief valve and filter components from the roadster. The V8 didn't have the coarse screen shown here, may have been left inside. Note all the shims go between the valve plunger and the spring, increasing overall thickness sharpens/speeds-up engagement, reducing overall thickness softens/slow engagement:
Yet another variation, a cylinder with cut-outs at one end, in place of my roadster coarse screen. Note that John Twist shows this type with the cut-out facing the hex plug, and not as here. It could make a difference if the oil has to flow back up the tube to escape from the slots rather than exiting directly, and is maybe why it was changed to the coarse screen I found which can be fitted either way up. *Photo: Corky*

I didn't find the valve ball, valve spring or low-pressure valve plug shown in the factory drawings on either car. The drawing in the Workshop Manual isn't very clear, it is much clearer in the Parts Catalogue although it still doesn't show the coarse screen I found in the roadster. However only the Workshop Manual has the full parts listing, the Parts Catalogue groups all the components together as 'Valve relief and low-pressure'. Below is a composite using the Parts Catalogue drawing and descriptions based on the Workshop Manual:
Plastic squeezy bottle for gear and diff oil, with a flexible spout that just fits in the length of tubing, and the tubing just fits in the filler hole on both side and top fill gearboxes. The snug fit between spout and tubing means that even though the 'join' is horizontal when filling in the footwell no oil leaks out from it. But put plenty of cloths and paper down over your carpets just in case, I still split a little. This tubing is probably longer than it needs to be even for the side-fill gearbox:

Location of the access hole and bung AHH6507:
Loop of cord on the dipstick to aid removal:
The bung isn't pushed all the way in, just until the body panel slots into the groove (arrowed):
Note that the bung is still present on rubber bumper cars with the side-fill gearbox, pre-77 at least, so those gearboxes can also be filled from the cabin. The Parts Catalogue for 77 on also includes it, suppliers give various info - '62-67' or 'CB' which is obviously incorrect, Moss says '62-80'. For it not to be needed on later cars the tunnel would need to have been altered, which seems unlikely. Some have said the 77 and later console doesn't give access to it (if there), but looking at consoles the fixing holes look to be the same distance from the rear edge on both types, which would mean the panel they screw into would have to be further back, which also seems unlikely.

**Overdrive - D-Type (to 67)**

Overdrive relay location, with vacuum switch below, image from Ste Brown, West Yorkshire, UK:

A description of the vacuum switch, its component parts and its calibration can be found [here](#).

Hover over a wire to confirm the colour

**Schematic:**
Note 1: On 62-64 cars the manual switch is wired back to the ignition switch. On 65 to 67 cars it is wired to terminal 3 of the fusebox.

Note 2: On 62-64 cars the relay contact is wired back to terminal 3 of the fusebox. On 65-67 cars it is wired to a 6-way bullet connector in the mass where the main, rear, gearbox and OD harness all join together near the bulkhead.

When the manual switch is closed the relay is operated, and the relay contact energises the solenoid via the gearbox switch if closed, and overdrive is engaged. At this point the condition of the vacuum switch - open or closed - is immaterial.

Assume now that with overdrive engaged the engine is doing high rpms but the throttle is closed i.e. it is on the overrun. This will create a high vacuum in the inlet manifold which will close the vacuum switch. If the driver now opens the manual switch, the vacuum switch being closed will continue to maintain a 12v supply to the relay winding from the relay contact, independently of the manual switch, so the relay remains operated, the overdrive remains engaged, regardless of the fact that the manual switch has been turned off.

Imagine now that either the speed of the car has slowed so that the engine revs are closer to idle, or the clutch is dipped so allowing the revs to fall to idle, or the throttle is opened again. In all cases the vacuum in the inlet manifold will reduce, allowing the vacuum switch to open. This causes the relay to release (the manual switch is already open) and its contact disconnects 12v from the overdrive solenoid so disengaging overdrive.

Fusing: A single fuse could be inserted at point A where the relay and vacuum switch harness joins the gearbox harness with two yellow/reds. But to protect the gearbox and vacuum switch harness as well one would need to be inserted at point B (either at the bullet connector where the main harness joins the relay and vacuum-switch sub-harness with two yellows, or at the manual switch) AND at point C leading to the white in the relay and vacuum-switch sub-harness.

This picture shows a yellow wire from the manual switch coming out of the main harness joined to a yellow/red going into the gearbox harness as it would be on a 4-synch car. For the 3-synch with relay and vacuum-switch the yellow from the main harness will go to another yellow in the relay and vacuum-switch sub-harness. Insert fuse B here. Above it are three whites, on the 3-synch there will be a fourth white going to the relay and vacuum-switch sub-harness, insert fuse C here. (Image by David Farrar on the MGOC Forum)
Update January 2008 I was under the impression that the vacuum switch was to prevent OD being disengaged under conditions of "high manifold vacuum" (Leyland Workshop Manual) i.e. to prevent high reverse torque from damaging the OD. But info from Bruce Cunha indicates that the vacuum switch only opens at manifold depressions lower than 7 in. Hg., and so OD could only be switched out if accelerating significantly, i.e. a bit like a kick-down on an auto box. But the Workshop Manual talks in terms of it delaying the change "until the engine takes up the drive", which implies light acceleration with the inlet manifold depression significantly above 7 in. Hg. Subsequent discussion with the designer of the transmission system for the MGB confirmed that the vacuum switch was indeed intended to prevent disengagement unless the car was accelerating, but to give a smoother disengagement rather than to prevent damage. However they found the vacuum switches were unreliable and so deleted them opting for 'driver education' instead. However my 73 Drivers handbook says it (the LH-type) can be engaged and disengaged accelerating or decelerating, just not to depress the clutch while doing either.

Of course, if the gearbox should be taken out of an overdrive gear the gearbox switch will ensure that overdrive is disengaged instantly, regardless of the position of the manual or vacuum switches. 'Normal' gear changes, say from 3rd to 2nd, will usually allow the overdrive to disengage safely and not encounter the mechanical stresses that the vacuum switch and relay are designed to avoid.

The vacuum switch on its own cannot operate the relay and so cause overdrive to be engaged, the manual switch must be closed first.

The other thing to be aware of is that the manual switch will operate the relay, and the vacuum switch will keep the relay operated under conditions of high manifold vacuum even if the manual switch is turned off, when the gearbox is not in an overdrive gear. All this means is that when an overdrive gear is selected the solenoid will be energised and overdrive engaged as normal.

The later LH-type overdrive does not have this vacuum switch and relay, presumably the designers feel it is strong enough to take disengagement under conditions of high manifold vacuum without damage. Also the current taken by the LH solenoid is much less, so the relay is not required for that reason either.

February 2014: It should also be noted that on some makes and models with this overdrive unit the relay was provided even when the vacuum switch wasn't. This is because the initial current from the solenoid - the 'pull-in' current - is several amps, which is more than the rating of the manual switch. Once the solenoid has operated the pull-in coil is disconnected leaving just the 'hold-in' winding, which only takes from 1 to 2 amps. Whilst the standard overdrive manual switch will operate the solenoid without either relay or vacuum switch, the high initial current can result in premature switch failure, and some have reported this if they haven't bothered to fit the relay because they couldn't obtain a vacuum switch. However if you engage the manual switch with a closed throttle, i.e. vacuum switch contact closed, in an OD gear, it is initially the manual switch that powers both the relay and the solenoid, which initially takes a high 17 amps of current. It is only when the relay has operated that its contact takes over the load of the solenoid. It's said that the manual switch isn't up to the job of powering the solenoid, and I'm aware of at least one person who has had a couple of manual switch failures when using the circuit without the relay and solenoid. Some applications of this OD still had the relay when they didn't have the vacuum switch, which tends to support that. Ideally the
The manual switch does the job.
enough to get at both the OD and reverse light switches on the 3-synch, whereas on the 4-synch the rear crossmember and back of the gearbox has to be dropped as well. *Image from Moss Europe* Incidentally the 4-synch removable panel is shown the wrong way round by Moss with the hole for the gear lever at the front, it is towards the rear as shown here.

3-synch: The main reason for this picture was to show how the cover is moved backwards when a 4-synch gearbox is fitted to the earlier car. You can see the screws in the forward section, and the holes in the rear section which were for the remainder of the screws originally, but has been tack-welded in place.

For information on the 4-synch switch see here.

**Gearbox Switches**

Location of the reverse light and OD switches on a 3-synch gearbox...
... and a 4-synch (in this case a UK rubber-bumper with the side filler/level plug, chrome bumper had the same dipstick as 3-synch) gearbox:

Showing the large access panel on top of the 3-sync tunnel (left), as opposed to the small one on the 4-sync. This should be enough to get at both the OD and reverse light switches on the 3-sync, whereas on the 4-sync the rear crossmember and back of the gearbox has to be dropped as well. Image from Moss Europe Incidentally this shows the 4-sync removable panel correctly with the hole for the gearlever towards the rear, it is shown the wrong way round by Moss:
Chrome-bumper cars (both 3-synch and 4-synch) have the dipstick for gearbox oil level, rubber-bumper cars have the side level/filler plug. 77 and later models have the same switch arrangement as earlier 4-synch, but different wiring to cater for the gearlever-mounted manual OD switch.

Accessing the 4-synch OD switch is really tricky. But by removing the small panel on top of the tunnel, removing the bolts from the removable cross-member and lowering the tail of the gearbox as far as it will go, and levering the gearbox towards the right, I can get my hand in. If you have a 72 and later car with the centre arm-rest and cubby, cut the carpet around this access panel as well as round the gear lever hole, which means you don’t have to pull the tunnel carpet back to remove the panel:

Duct-tape over the edges of the hole to protect hands:
Keep the section from over the panel, and drop it back in place for noise reduction before re-fitting the arm-rest:

The 4-synch OD switch. You can't get a socket on the original switch so will have to use grips or a drift and hammer - carefully:
Vee's original OD switch on the left and a modern replacement on the right. The original design means that you cannot get a socket or ring or box-spanner over the end of the installed switch, only an open-ended or grips from the side, which isn’t possible with the 4-synch OD switch with the gearbox installed. On the modern switch the hex is the widest part, meaning a socket or box-spanner can be used, making removal and replacement on an in-situ gearbox easier. With a 16-point socket on a 1/2" extension bar the socket will go but with a very limited 'throw'. But by turning the socket on the bar 90 degrees at a time you can effectively get 32 points:

Switch out, wires tied to the gear lever to stop them dropping down out of reach:
Reverse light switch - different orientation, so can be reached from below with grips:

Typical switch and spacer. It's always been said they are fibre and there are two per switch. However Vee's OD switch spacer (here) is copper and there is only one. Most suppliers show it as fibre, and only one (as does the Parts catalogue) but Brown & Gammons shows the reverse light switch spacer as fibre and the OD spacer as copper, the same part as the master cylinder banjo washer:
Vee's reverse light switch and spacer. One fibre, thinner than the copper OD spacer above, smooth all over so not squashed down by the switch:

4-cylinder OD switch and spacers. Two, different sizes and thicknesses, one the same as Vees copper spacer the other slightly thinner:
Switch Internals

The plunger end, with the moving part consisting of two contacts. Very oily - and sulphurous, so gearbox oil has worked it's way up and in, rather surprising seeing as the switch is at the top:

The terminal end, with the fixed contacts. Two pairs - each bridged by one of the moving contacts, so two chances of making a good connection, particularly should the one that makes and breaks first becomes burned:
Once cleaned of oil very little signs of burning, so I don't know why operation had become erratic. This switch operated with quite a small movement of the plunger, but then became erratic as the plunger was moved further, and needed very firm pressure at full travel to make contact again:

Plunger with a O-ring (hasn't kept oil out!) and an 'overthrow' spring ... not for 'come the revolution', but to allow the plunger to carry on moving once the moving contacts have reached the fixed contacts:
Each moving contact bridges one pair of fixed contacts, and either will allow current to flow. No less than 18 individual components:

**Reverse switch actuation:** As the gear lever is moved to the right the selector lever (A) moves to the right and depresses the switch plunger (B) to operate the switch. As the lever is pulled back to go into reverse gear the selector lever moves up and keep the plunger operated. Also as the lever is pulled back the finger on the selector lever C slides up between the jaws of the reverse gear detent D. If the reverse gear detent is not in the correct position, for example if a forward gear is still engaged, the jaws of the detent will not be in a position to allow the finder to move up and so reverse gear will not be selected:
**OD Switch actuation**: 4-cylinder - round shaft, notch under the switch in the reverse and 1/2 plane, with a smooth transition at it moves to the left to activate the switch anywhere in the 3/4 plane. This gearbox uses selector lever 22B386 and isolation switch plunger 22B406:

4-cylinder selector lever 22B386 giving OD in 3rd and 4th. As the gear lever is moved to the 3/4 plane face 'A' moves towards the viewer and operates the OD plunger 22B406 to actuate the switch. As the gear lever is moved in a straight line between 3rd and 4th face 'A' keeps the plunger operated and the switch actuated. (*Oliveira & Valentim*)
This picture of the 4-cylinder OD plunger 22B406 is from a V8 register article, and they don't seem to be available.

Someone on the dreaded MGE says Moss Europe show it as the same as the 4-cylinder reverse plunger (pictured here 22B396), but they don't now. And there is a significant difference between this and the OD plunger in the V8 Register article in that the 'anti-rotation' and switch cut-outs are at right-angles to one another, as well as being reversed along the pin i.e. here the switch cut-out is closer to the head whereas in the picture of the two OD plungers the 'anti-rotation' cut-outs are closer to the heads: (Brown & Gammons)

V8 with OD on 4th gear only - similar notch under the switch. This gearbox uses selector lever 22B726 and isolation switch plunger 22B727:
Normally the plunger only moves to the left as 4th gear is selected, and on Vee only goes about half-way, and has a different shape with a sharper transition than the 4-cylinder plunger:

Once in 4th if the lever is pulled further across towards the driver the plunger moves even further, which is not a problem. But when in neutral and 3rd gear it also starts to move if pulled across like that, so adjustment of the switch spacing is pretty critical. With a new switch and a thinner 40 thou spacer (in an attempt to get a more reliable engagement) the switch was operated all the time. With the original 50 thou spacer the switch operated reliably with the gear lever used normally, but it also operated if pulled towards the driver in neutral and 3rd. It took an additional 15 thou of spacing (front wheel bearing shims!) to stop that happening, but still leave it operating in 4th:
V8 selector shaft 22B726 giving OD in 4th only. As the gear lever is moved to the 3/4 plane the socket in the selector lever moves towards the viewer. But it is only when the lever is moved into 4th gear that face ‘A’ moves to the left to contact the plunger, and actuate the switch:

V8 plunger 22B727, with a 2-stage switch cut-out at A, location cut-out at B, location pin 22H576 at C, and return spring 22H204 (NLA) at D. The location pin prevents the pin from rotating to keep the switch cut-out under the switch. The fatter and chamfered head allows for a smoother operation of the plunger and switch than a flat head:
The location pin can be drifted out through the hole on the underside of the tower arrowed, and the plunger and spring withdrawn. The smaller hole to the left is a drain hole, so any oil that gets down the sides of the plunger is pumped back into the gearbox as the plunger is operated, otherwise it would be forced into the switch and probably leak out from that:

The pin partially drifted out. On replacement make sure the plunger is correctly aligned before tapping the pin back home:
Overdrive - LH-Type

LH type without ignition relay (68-76 and V8):

On cars with the dash-mounted manual switch to protect the most wiring insert the fuse in the white wire at A where it connects to the back of the switch. On cars with the column switch - to avoid cutting wires - insert it at B where the gearbox harness joins the main harness below the pedal box.

LH type with ignition relay - UK (77-on):
On cars with the gear-lever mounted switch to protect the most wiring a fuse can only be inserted at A where the gearbox harness joins the main harness.

LH type with ignition relay - North America (77-on):

A fuse inserted at A will protect both the OD and the TCSA circuits, this is probably where the gearbox harness joins the main harness. However there is also position B: In the wire from the inertia switch a single fuse will protect the OD, TCSA and fuel pump. But a fault in the OD or TCSA wiring will also cut off the fuel pump, so it is better to use two fuses - one in each of the wires coming from the 4-way bullet connector at B.

This picture shows the yellow wire from the manual switch coming out of the main harness, joined to a yellow/red going into the gearbox harness. Insert the fuse here. (Image by David Farrar on the MGOC Forum)
Note: For a few months from late 76 to Feb 77 the original gearbox Overdrive switch operating in 3rd and 4th was used plus an additional TCSA (Transmission Controlled Spark Advance) microswitch operating in Reverse, 2nd and 4th. Wiring these two switches in series allowed the TCSA i.e. vacuum advance to be enabled in 4th gear only whilst Overdrive was still available in both 3rd and 4th. In Feb 77, possibly due to unreliability or cost considerations, the microswitch was deleted and the Overdrive switch arrangements changed to operate in 4th gear only, feeding both the TCSA and Overdrive. With this arrangement the output of the gearbox switch fed both the Overdrive manual switch and the TCSA solenoid directly, so OD was only available in 4th gear.

Is this (A) the TCSA switch? Certainly a microswitch as per the original description I had read, and it closes in Reverse, 2nd and 4th as the gear change shaft (B) moves forwards in those gears:
The location of the gearbox Overdrive and reverse light switches. This is a UK rubber bumper 74.5 to 76, but the switches are the same on all four-synch gearboxes:

![Image of gearbox showing Overdrive and reverse light switches.]

Showing the much smaller removable panel on top of the 4-synch tunnel (right) compared to the 3-synch, so you will probably have to lower the rear crossmember and back of the gearbox as well. Image from Moss Europe. Incidentally the smaller removable panel is shown the wrong way round by Moss, the hole for the gear lever is towards the rear as shown here, not towards the front:

![Images of removable panels turned the wrong way round.]

3-synch: The main reason for this picture was to show how the cover is moved backwards when a 4-synch gearbox is fitted to the earlier car, but you can see the screws in the forward section, and the holes in the rear section which were for the remainder of the screws originally, which has been tack-welded in place, with a filler-strip:
4-synch: The much smaller removable panel, with the hole for the gear lever positioned to the rear, and not how Moss show it in their drawing. By removing the bolts from the removable cross-member and lowering the tail of the gearbox as far as it will go, and levering the gearbox towards the right, I can get my hand in. The reverse light switch should be easier to get at from below with channel-lock pliers, as it is lower down and faces sideways. If you have a 72 and later car with the centre arm-rest and cubby, cut the carpet around this access panel as well as round the gear lever hole, which means you don't have to pull the tunnel carpet back to remove the panel:

Keep the carpet section from over the panel, and drop it back in place for noise reduction before re-fitting the arm-rest:
With the panel removed, crossmember dropped and gearbox levered to the right, you can get at the switch wires more easily. I found I needed to remove these wires from the switch to be able to pull the solenoid bullet connector up far enough, or down far enough, to part or reconnect it. With the wires removed you can get a drift in which will hopefully tap the switch round until you can get a smallish hand in to fully unscrew it. If you can't get a hand in then I think you will struggle to get the switch thread started on refitting:
Switch removed, wires tied back to the gear lever to stop them dropping out of sight:

Original switches (left) have the hex smaller than the terminal end, so you can only get an open-ended spanner or grips on them from the side, which isn't possible with the 4-synch OD switch with the gearbox in-situ. However replacement switches (right) have the hex as the widest part, so I'm hoping with Vee's replacement switch (the old one is intermittent) I can get a socket or box spanner on it to make sure it is tight.
Solenoid assembly ...

... disassembled.
The spacer lifts the coil up, so the plunger is pulled upwards when the coil is energised. Without it the plunger is as likely to be pulled downwards as upwards. However without any of the case fitted, there is almost no magnetic force on the plunger when the coil is energised and it doesn't move at all. With the outer case and bottom cap fitted the plunger moves up slightly as shown. But when the top cap is fitted there is a very strong attraction upwards. You can pull the plunger most of the way out of the bottom, and powering the coil will pull it all the way in and against the top cap with a real smack. It has to resist 400-420 psi of oil pressure in the 4-cylinder OD, and 510-530psi in the V8.

Ball-seat inside top cap
Plunger and ball, small O-ring arrowed, which prevents oil escaping down the inside of the solenoid, and leaking from the cover. The slot in the plunger prevents air-pressure or leaked oil pressure resisting the movement of the plunger. When the plunger presses the ball against its seat oil cannot flow from the inlet to the outlet of the top cap, the pressure rises at the inlet, and OD is engaged.

Top cap. When OD is engaged and oil is not flowing from the inlet to the outlet, the medium O-ring prevents oil escaping past the ball when on its seat, which would result in pressure loss. The large O-ring prevents oil escaping down the side of the solenoid, which will leak past the cover.
In the released position the ball and plunger should be pushed back so releasing oil pressure. With a sound small O-ring the plunger is unlikely to fall back under its own weight, which is why - apart from possibly the first time the coil is powered after the car has been driven - you won't hear any noise from it, unlike the 3-synch solenoid. If the plunger doesn't move back far enough there may be enough residual pressure to prevent the operating pistons and clutch sliding member moving fully back from the annulus to the outer casing so it can't fully engage direct drive. While the clutch sliding member is between the two there is no engine braking (you still have drive as until OD is fully engaged the one-way clutch is bypassing the slipping clutch) and you get a distinctive 'pulsing' sensation. However under normal circumstances the plunger comes back at least 2mm when the solenoid is released, giving a clear path through the valve, as can be seen here.
Solenoid coil, with earthing spring. Flat on Bee's removed coil on the left, whereas opposite sides should be bent up to form a spring, as with the new one on the right.

LH Solenoid Covers

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:


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
The 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:

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 - '1972' 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. Also the earlier 'Laycock/Birfield' plate, so maybe Vee has had a replacement OD:

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:

Reputedly an MGC plate with the same reference number as Vee's above, but 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:
LH Overdrive Pump

Images from Moss Europe.

The end of the pump carrying the roller has a rounded side ...

... and a 'machined' side. The flat points towards the rear of the car and slides up past a similar face on the casing. I say 'machined' as this surface looks very rough and irregular indeed.
The flat must be aligned correctly or the roller will be held away from the cam and the pump will develop no pressure. Fit the pump with the output shaft (i.e. prop-shaft if in-situ) rotated to put the lobe of the cam uppermost i.e. away from the pump piston. With the pump fitted if you peer up inside with a good torch you can see the cam and pump plunger, and when the output flange/prop-shaft is rotated you should be able to see the pump plunger moving up and down. Nathan said he had to tighten the pump plug gradually checking the plunger would still move each time otherwise it was catching.

The pump components from the Laycock manual:

33 - Pump plunger
34 - Pump spring
35 - 'O'-ring
36 - Pump body
37 - Non-return valve seat
38 - Steel ball
39 - Non-return valve spring
40 - Pump plug
41 - 'O'-ring

Fuel Pump and Overdrive Fusing

Damage to the V8 rear harness inside the boot. The fact damage is visible here shows the short must have occurred either in the pump or closer to it than this point. Damage runs all the way back through the rear harness and into the main harness, through that back to the ignition switch, and from there on the brown down to the solenoid. This has happened to both my roadster and V8 before my ownership. The roadster is still using the original wire so presumably wasn't damaged too badly, the V8 has had a
new wire run in (brown, the blue is a wire I added for the rear fog lights). It also shows why fuses must be as near to the supply as possible. If there had been a fuse near the pump then it would have prevented the damage from this short in the pump, but if the short had happened in the rear harness under the car the fuse wouldn’t have blown and the same damage would have occurred in the rest of the wiring.

The bullet connector near the RHD pedal cover where the two white wires from the main harness join the white wire to the rear harness and the pump. Note the heat damage to the pump wire on the left of the connector, insert the pump fuse between this wire and the 4-way connector. On 77 and later the white wires from the main harness are white/brown, also there is a fourth wire - also white/brown - which goes into the gearbox harness for the overdrive circuit. You can take both the output wires into a new 4-way bullet connector and insert a fuse between the two 4-ways, but if one circuit blows the fuse it will stop the other working. Better to use one fuse for each. North American spec cars are wired differently as they have an inertia switch in the pump circuit, and the OD wiring is different, see the main text. (Image by David Farrar on the MGOC Forum)
**V8 Pump and Overdrive fuses:** They should be installed as close as possible to the supply where a unique wire can be accessed. I've inserted them at existing spade and bullet connections which avoids cutting into wiring. It is also reversible - should anyone want to! I had to put the V8 overdrive fuse in the engine compartment as that was the first place I could use existing connectors as it has the manual switch on the column stalk with a multi-way plug connecting to the main harness. On the roadster with the manual switch on the dash I have put the fuse on the back of the switch using spade connectors instead of bullets. When I had a major overflow from one of the V8 carbs the close proximity of the two allowed me to cross-connect them so I could use the overdrive switch to turn the fuel pump on and off!

![Image of V8 Pump and Overdrive fuses](image)

Top cap. When OD is engaged and oil is not flowing from the inlet to the outlet, the medium O-ring prevents oil escaping past the outside of the solenoid, which would cause pressure loss. The large O-ring prevents oil escaping down the side of the solenoid, which leaks past the cover.
In the released position the ball and plunger should be pushed back so releasing oil pressure. If it doesn't move back far enough there may be enough residual pressure to prevent the operating pistons and clutch sliding member moving fully back from the annulus to the outer casing so it can't fully engage direct drive. While the clutch sliding member is between the two there is no engine braking (you still have drive as until OD is fully engaged the one-way clutch is bypassing the slipping clutch). However the plunger comes back at least 2mm when the solenoid is released, giving a clear path through the valve, as can be seen here.

The standard solenoid gasket. If a thicker or second one of these is fitted both the solenoid body and the plunger will move out from the overdrive casing by the extra thickness. But as the seat of the valve is part of the solenoid assembly, that will move out as well, so the plunger and the valve seat will have the same relationship and travel as before. Also by allowing the whole solenoid assembly to move back you will take the pressure off the large sealing O-ring, and oil will travel down to the cover.
and gasket, and almost certainly leak out. (Image from Legacy Classics)

If a second gasket were to be fitted between the existing gasket and the cover plate, with a hole large enough to allow the plunger to move back as far as the cover plate, but not large enough to allow the solenoid body to move back, this may well allow the plunger to move back far enough to solve the problem. However that will possibly cause another problem, by the secondary gasket insulating the solenoid assembly from the cover plate, and hence from the OD body, and earth. The spring on the solenoid coil is compressed when the solenoid is clamped between the bottom cover and the O-ring, and is how it makes its earth connection to the solenoid body. The solenoid assembly is then clamped between it's large O-ring and the bottom cover to make an earth connection with the outside world. Although the whole of the solenoid body can be used to provide an earth, and the sides of the body are in contact with the OD casing, it is not a pressure contact, so the earthing, and hence OD operation, may become unreliable. The question also has to be asked - why isn't the plunger coming back far enough? If something is physically preventing it from coming back as far as it should, then allowing more space isn't going to help - unless the obstruction is directly under the plunger. And if it is coming back as far as it should be, then something else must be keeping the pressure higher than it should be. This could be an obstruction in the solenoid top cap, or possibly the relief valve assembly.

**Modified Overdrive Circuitry**

by Graham White

_Graham writes:_

Having recently visited your site and looked at your O/D sequencer circuit, particularly the caution about the danger of mixing overdrive and reverse at the same time I realised that my circuit offers (I hope) several safeguards against this happening, plus some additional benefits.

My circuit uses one relay RL1 to control the over drive, with a second relay to power the reverse lights. This second relay
RL2 is a single pole changeover that removes power to the over drive when reverse is selected. Now, with no power to RL1 any damage, shorts or stuck points, the over drive can not be engaged. RL2 also powers my 25 watt reverse light enabling the gear box switch to only pass a few milliamps, so extending its life.

The over drive dash switch is a three position non latching, centre off switch with a long stalk. Moved briefly up to engage, briefly down to cancel. As you follow the circuit you will see that after initially passing full coil current to turn on RL1 it remains held on with about half the engaging current via R1 so the coil will not overheat. Switch "3-4" is the original over drive switch. The “SELECTOR SWITCH” is an extra switch, normally closed that briefly goes o/c as the gear lever is moved between third and forth or forth and third. This automatically disengages the over drive when moving from over drive top down to third when maximum acceleration is required. If not always req'd a dash mounted switch can be added to over ride its action.

In your picture of the gear box switch positions the anti rattle plunger holder can be seen mid way along the gear lever extension casting (arrowed below). The plunger, now with a ball bearing in the end & pressing on the selector shaft, trips a micro switch (mounted on the plunger holder) when passing a very small depression cut in the shaft. For added safety all the gearbox mounted switches are wired to the negative, chassis side of the circuit, so no fire or burnt wiring!

Graham subsequently emailed:

"I now realize that I have left out one important component in the circuit I sent you. I omitted to draw a blocking diode in series with the 75 ohm resistor. Its purpose is to ensure that if the O/D switch is held ON, in first or second the solenoid will not be powered by current flowing from the switch through the resistor."

Note that the diode needs to be connected appropriately depending on whether your car is positive earth or negative earth. However in my tests with the LH overdrive the solenoid would not reliably operate with 25 ohms in series, and would not operate at all with 35 ohms in series. The earlier D-type overdrive requires significantly more current to operate so is even less likely to operate without a diode. So being powered with Graham's 75 ohm resistor is series should not cause any problems, but then neither will putting in a diode to be sure.

I also strongly recommend fusing the ignition supply to the circuit, as I do to all overdrives (and fuel pumps). Graham tells me uses fused relays, but as far as I can see these are only available in the basic ‘on-off’ flavour i.e. RL1 and not with the 'changeover' type RL2, which does leave some components and wiring unfused.

**Overdrive Sequencer - all-electronic**

This circuit works in exactly the same way as my original circuit - i.e. the existing manual switch is used to ‘reset' the circuit once automatically locked out as well as engage or disengage OD manually. The LED shows when OD has been locked-out i.e.
whenever the manual switch is closed but the gearbox switch is open.

This circuit has been bench-tested, but needs to be tested on-car to check for any unwanted operations. Cars of our era are very 'noisy' electrically with many spikes and random pulses as things are turned on and off, as I have found with purely electronic circuits in the past, and a commercial version of this suffers from this problem so I've been told. It's not something I've ever encountered with my original circuit, quite possibly the brief (in our timescales) time that a relay needs to operate and release is able to ignore microscopic (in time and voltage) hiccups in the signal from the electronics.

The characteristics of a thyristor are such that once a signal has been connected to the gate 'g' and turned the thyristor 'on', which allows current to pass from the anode 'a' to the cathode 'c', the gate signal can be removed and the thyristor will continue to conduct until something else interrupts the current. This can be the manual switch (to turn OD off manually), or the gearbox switch opening when changing out of an OD gear, or turning the ignition off.

The capacitor enables this to be achieved solely with the original manual switch, and not need two other push-buttons that have to be mounted somewhere, as other systems need. The capacitor supplies a brief pulse of +ve voltage to the gate as it charges up when the manual switch is turned on, and this is enough to turn the thyristor on. The 10k resistor in parallel with the capacitor ensures that the capacitor can discharge when the manual switch is turned off, as if the capacitor is still charged when turning the manual switch on again it will not generate a pulse to turn the thyristor back on again. Note that opening and closing of the gearbox switch will not re-engage OD as this does not generate a pulse to the gate, only turning the manual switch on (or off and back on) will do that.

R1 and R2 form a potential divider to give a reduced voltage to the gate - in the order of 2v or so - as required by the specification of the device. This is despite the thyristor itself being rated at 650V and 13A, which is deliberately way over-kill for the 12V and 1A of the OD.

The LED will glow when OD is locked out i.e. the manual switch is on, the gearbox is in an OD gear and that switch is closed, but the thyristor is not triggered. The LED 'sees' 12v from the manual switch, and an earth via the gearbox switch and solenoid, and as the solenoid resistance is only 15 ohms that is more than enough for the LED.

The LED can be changed to act as an 'OD engaged' indicator by moving its +ve connection to the thyristor cathode and its -ve connection to earth.

**Overdrive Sequencer and North American 1977-on Cars**

Adding the overdrive sequencer circuit to North America is complicated by the order of the driver's and gearbox switches in the circuit being reversed, as the overdrive circuit was linked with the Transmission Controlled Spark Advance system that was added shortly after the driver's switch moved to the gear lever. Clausager indicates that the gear lever switch was added at car number 410001 in June 76, and TCSA started to be provided at car number 411635 in July 76, finally fitted to all cars by 429084 by Feb 77. With TCSA 12v is connected to the gearbox switch first, then the output of the gearbox switch controls both the OD and the TCSA. The output is split into two, one branch going to the TCSA system, the other branch going to the driver's switch and then to the OD solenoid.

If you don't have or don't need TCSA, then you can rearrange the wiring such that the 12v supply on the white/brown and yellow/purple goes to the gear lever switch first, then from there to the gearbox switch, and from there to the solenoid i.e. the original order of components. Then you can simply (accessibility aside) insert the sequencer circuit between the manual and gearbox switches and it will function as intended.

If you have TCSA but don't need it for emissions inspections then with the wiring rearranged as above the driver's switch will be controlling TCSA instead of the gearbox switch. To prevent that the simplest thing is to remove the TCSA solenoid from the distributor vacuum pipe, and join the two halves of the pipe together. This will give you vacuum advance in all gears instead of just 4th gear. Clausager says the TCSA system was provided to prevent 'surging' in the lower gears by restricting vacuum.
advance to 4th gear only, so if you make this change you will have to see if it gives you that problem. I'd recommend making this change before doing anything about the sequencer circuit, so if you do have 'surging' problems and decide you still need TCSA, you will have to think again about adding the sequencer. It is technically possible to add the sequencer, or different circuitry to achieve the same effect, with the gearbox and driver's switches in this order, but they involve adding circuitry and components to the solenoid side of the gearbox switch. And if any fault should develop that allows 12v to continue to be extended to the solenoid when the gearbox switch has opened, you could find yourself reversing with overdrive engaged and destroy the unit. Because of that I'm not prepared to suggest any of these other options.

**Overdrive Sequencer Relay**

Schematic

![Overdrive Sequencer Relay Schematic](image)

6RA relay can containing the electronics, and a modern single-pole, double-throw relay

Warning light fitted in a convenient space between steering column and dash
The revised position, a small bracket with a hole for the LED below a smaller hole for the fixing screw for the door seal end-cap sees it neatly positioned at the end of the dashboard crash-pad, and pleasingly close to the manual switch.