NEW Index Body Brakes Clutch Cooling Electrics Engine Fuel Gearbox Heater Ignition Propshaft Rear Axle Steering and Suspension Wheels and Tyres Miscellaneous

# Clutch

*Last updated 29-Dec-2017*



Bleeding Bore Sizes Clevis Pin Wear Clutch Change Flex-Hose Fluid How It Works Master Cylinder Pedal Box
Pedal Return Spring Release Bearing
NEW Release Arm Gaiter Slave Cylinder Links
**The sectioned MGB at the British Motor Museum, Gaydon**

## Bleeding

Recently changed all the V8 clutch hydraulics. Only the m/c was bad (leaking back) but decided to change the hose and slave while the system was down. So many people have complained that the clutch is a pig to bleed - worse than the brakes (and they are bad enough) that I wondered if there was a better way. What about reverse bleeding it some how, so the air was pushed in its natural direction rather than straight down? In fact, what about **filling** the system from the slave?

My Gunsons EeziBleed came with two pipes for draining the slaves into jam-jars - a narrow bore that fits the rears, and a wider bore that fits the calipers and the clutch. I discovered the larger bore tube is also a snug fit on the bit of pipe that protrudes through the cap that screws on the m/c during normal bleeding, so used it to connect the cap to the clutch slave, which was dangling down on its flex pipe. I connected the Gunsons bottle to a spare with just 10 lbs in it, checked that fluid wasn't spurting out everywhere, then opened the slave bleed nipple. Stand by the clutch m/c, which has the cap off, looking and listening. After a few seconds I hear some gurgling then see clear golden liquid slowly rise up the sides of the m/c. When it reached about half-way I got back under the car to close the bleed nipple and disconnected the air and the Gunsons tubing. Got my faithful assistant to pump the clutch while I measured the travel and compared it with the measurement I had taken before I started. It was spot-on, or possibly a fraction more - looking good. Gingerly try the clutch with the engine running, and the biting point is just where it should be.

What's the bleeding time (as the surgeon said to his pupil)? About five minutes.

Bear in mind that if you use this method without replacing the slave you could push any debris that is lurking in it up to the m/c. However you may be able to get away with it if you flush the system through with clean fluid by pumping the pedal, then drain it again before refilling with fresh fluid from the slave as described above. I haven't tried it, though.

*Update August 2004:* This simpler method using the same principle of reverse bleeding is based on a posting on the MG Enthusiasts MGA Bulletin Board by Ian Pearl in Ireland which came to me via Dave Dubois:

> Connect a bleed tube from the clutch slave to the front right brake bleed nipple. Make sure the brake master is fully topped up and the clutch master has room for more fluid, removing some if necessary. Loosen both brake and clutch bleed nipples (you may find that the bleed nipple on the clutch slave only needs the slightest turn as it can be quite loose fitting). Pump the brake pedal twice. Check the brake master fluid level and top





> up, check the clutch master is not close to overflowing. Pump the brake pedal three more times and tighten up the nipples. This is a reverse bleed and can be done single handed. Check your clutch operation after this and repeat if necessary. Finally correct the level of both masters.

Note that it is probably advisable to close one of the nipples before each up-stroke of the pedal to avoid drawing air from the tube into the brake system. It would also be preferable that this was the brake nipple, to avoid drawing air past the threads as well. Remember that if you have pushed fluid out on the pedal down-stroke, that needs to be replaced by fluid from the reservoir during the up-stroke, but the by-pass hole is only uncovered when the master piston has fully returned. Therefore the fluid has to be sucked past the master pressure seal, which can only happen by developing a negative pressure in the line, hence the risk of pulling air back into the line at the slave bleed nipple.

*August 2015:* An even simpler version is to interconnect the caliper and clutch slave as above, but instead of using the brake pedal connect your Gunson's to the **brake** master, opening the caliper bleed nipple last and closing it first. Again best used on a clean if not empty system.

*Updated October 2006 and November 2009:*

I've seen several comments that if you push the slave piston all the way back into the cylinder, and clamp it there while you are bleeding normally with the pedal or Gunsons on the master cylinder you don't get the problem of trapped air. A nice idea as the piston is normally not at the bottom of the cylinder bore and so there is fluid and the potential for trapped air behind it. But it shouldn't be necessary for conventional bleeding because if you look inside the cylinder you will see that the bleed hole is drilled along the join of the cylinder and back walls at the top edge, cutting away an arc about 3/8" wide, rather than just being a small hole like the fluid entrance has, and the cylinder is also tipped up slightly in that direction (unless the car has a marked nose-down attitude). In theory this ought to be required for reverse bleeding as you are trying to push air out of the inlet port which is halfway down the side of the cylinder. But practical experience shows that it's much easier to bleed the clutch using reverse bleeding than conventional, **without** pushing the piston back. This treatment can be useful though, to push air that has gathered in the loop of pipe at the top of the engine compartment back through the master and into the reservoir. You do have to be careful **after** pushing it in though, if you simply let it go the spring in the cylinder will tend to push the piston back out again, which can pull air in again past the seal, the seal only being effective in one direction. With the piston pushed in you (or someone else) should operate the clutch pedal to push the piston back out i.e. while you are still attempting to restrain it by hand.

*Update June 2007:* An acquaintance has just bought a non-runner, one of the problems being the clutch went to the floor with no resistance. The master was full, but when opening the slave bleed nipple just a gurgling and a few drops of liquid came from it when the pedal was pumped. So first I tried the October 2006 tip of wedging the slave piston all the way into the cylinder but nothing changed. So then we siphoned the fluid out of the master (to prevent it overflowing) and connected the bleed nipple to the right-hand caliper to try the August 2004 tip. They are the same size so this was easy. Gentle operation of the brake pedal (do it too quickly and you will blow the pipe off one or other of the nipples) got fluid flowing, and we kept pumping until the clutch master was full again. This was a 1978 with the large plastic brake master reservoir so there was no risk of lowering the level too much and then having to bleed the brakes. Did up both nipples, the clutch pedal now had normal pressure, and the slave push-rod was moving the normal 1/2" or so. Started it up, selected reverse with no grinding, and the biting point was about mid-way i.e. where it should be. So eminently successful, and easier than using the Gunsons to reverse fill/bleed, the only thing to remember is to remove some fluid from the clutch master to begin with.

*Update November 2012:* Vee's slave needs replacing again as it is losing fluid. This time, as it was only the slave and the rest of the system was still full as I clamped the hose, I didn't have to do any conventional bleeding at all either top down or bottom up, see here.

*July 2014:* Someone on the MGOC Bulletin Board has said that he read somewhere that just pumping the pedal about 40 times bled a newly filled system, so after replacing the slave and refilling tried it, and it worked! However I tried that and all it did was aerate the fluid (made it 'milky'), which all had to be pumped out with conventional bleeding.

*August 2015:* Bee's pressure seal started leaking back intermittently, and as the bore was good I decided to change the seal. That was OK, but bleeding was a nightmare, and I eventually used all of the above one after the other before I could get anything like decent slave piston movement.

*July 2016:* Bee's clutch had to be changed, so I changed the slave and flex hose at the same time given the difficulties accessing the top end of the hose and the chassis bracket with the engine in-situ. Filling and initial bleeding was done conventionally with a Gunson's top-down, which left a soft pedal and low biting point. I tried several of the processes above but the one that seemed to do the best was removing the slave from the bell-housing, letting it hang, and pushing the piston as far back into the bore as it would go. More detail here.

## Bore Sizes

MGB and V8 master and slave bore sizes differ as follows:

MGB M/C: 19mm
MGB slave: 32mm
i.e. a ratio of 0.594:1.
V8 M/C: 17.8mm
V8 slave: 25.4mm
i.e. a ratio of 0.701:1, i.e. more slave movement for a given pedal movement, which seems a little odd as the V8 clutch should be heavier than the 4-cylinder. Ironically the V8 uses the same master and slave as some Midgets.

## Clevis Pin Wear

Bee's clutch has always engaged near the floor in my ownership. Looking at the pedal, m/c push-rod holes and the clevis pin there was obvious wear (see pics). I swapped the clevis pin with the brake as a short-term measure, which showed negligible wear, and it improved things a little. Since then I have often pondered what to do about the pedal (the other two items are easily replaceable). Fully welding and re-drilling? - Maybe tricky without a pillar-drill. Over-drilling and using a bigger clevis pin? - I'd have to over-drill the push-rod, and any replacements, as well. Over-drilling and inserting a sleeve? - Where to get the sleeve? Or filling the worn part with weld and filing it out? - Would roughness cause accelerated wear in a new clevis-pin? Eventually the replaced clevis pin wore as well and again engagement was closer to the floor than I would like.

I decided on the last option - if I have to replace the clevis pin from time-to-time then so be it. But first I measured the wear on all three items. Using a good push-rod I reckoned the diameter of the holes in pedal and push-rod should be 0.316" - mine were 0.368" in both. The diameter of the clevis pin at the split-pin end was 0.309" but where it contacted the push-rod it was 0.299" and at the pedal was 0.292". That wear added up to a total of 0.13". Considering that the pedal has a leverage of some 4:1, that means about 0.5" of extra travel at the pedal pad.





I MIG-welded up the worn side of the hole gradually, filing it out from time-to-time while I could still get a small file in what was left of the hole, which also let me fill in any cavities between 'lumps' of weld.

It only took a couple of hours to dismantle, get a reasonably smooth and complete hole, and reinstall. And even though I still need to get and fit new clevis pins (replacing the worn one in the brake as well) clutch engagement is noticeably higher than before - close to that of the V8 which doesn't seem to have any visible wear. Well worth it.

*Updated August 2008:* Note that any mechanical wear at the slave end i.e. push-rod, clevis-pin, clutch arm etc. is compensated for by the design of the hydraulic system. It is, after all, designed to take account of wear in the release bearing which can be at least half an inch, any wear in the other components is miniscule by comparison.

## Clutch Change

Rubber bumper, removing engine only, 2008

Chrome bumper, engine and gearbox removed together, 2013

NEW **Bee's clutch change** *July 2016*

Previously replaced in 1994 I foolishly opted for an after-market roller-bearing release-bearing. As recounted elsewhere almost from the start it was making squeaking and wittering noises, then graunching noises in 2014, and finally this year I noticed it was dragging the idle down i.e. had seized. As this means excessive wear would now be taking place I started keeping a close eye on the clutch fluid level, as that is a good indicator of the wear. Finally the wear got to such a point that the slave cylinder started weeping, presumably the piston and seal having moved along the cylinder to a place it had never been before, possibly rough or corroded, where it couldn't seal. So that's it, change due.

I borrowed the same hoist as for the 2008 change, although as this would be done in a single-width garage there was no opportunity for lifting the engine from the side of the car as I'd had to do for the rubber bumper as the arm wouldn't reach the middle of the engine. Hopefully being chrome bumper it might reach ... but no, so the bumper and grille have to come off, and when horizontal the end of the arm reaches just past the middle of the engine, which is a relief. Another consideration doing it in the garage is do I have enough clearance to the ceiling to lift the engine over the slam panel. Up and over garage doors would reduce the available height still further, but as mine is a double-length garage I'm doing it in the middle so well clear of the open door. This also gives me plenty of space at the back for removed parts, and plenty at the front for the hoist and engine when it is removed so I can just shut the door on it all at night. The front of the car will need to be raised to get at the lower bell-housing bolts at the very least, again reducing the available space.

With the car in the middle of the garage the back wheels are on the lowered full-length ramps which raises it just enough to slide under to get at the middle exhaust clamps. It's quite close to the wall that side so reaching under from the side isn't an option. As I've previously found the drive-on ramps skid on the concrete floor if I try to drive up, I jack up the front of the car so I can slide them under the tyres. This hoist fits between drive-on ramps under the front wheels of the car, but the available height reduces still further as you take the weight of the engine on the hoist and the body rises on the suspension. A large hoist with long legs with the ends wide apart may not fit between drive-on ramps, so you may have to use axle-stands further back under the chassis rails. This will eliminate the problem of the body rising on the suspension as the hoist takes the weight of the engine, but I preferred the security of the ramps.

This time a leveller had been supplied with the hoist, but as that increases the distance between the end of the hoist and the top of the engine the arm has to be raised higher, and that brings the point of lift forwards from the middle of the engine as well as closer to the ceiling, so I decided to use the tow-rope under the front and the back and crossed over on top as I had before.

Then it was a steady plod disconnecting/removing everything. But first I redrilled the holes in the bonnet hinges to aid reassembly - they were on both pieces but didn't line up. Don't know why as alignment has always been good. Then a pal came round to help me lift it off. Next was bumper complete with number-plate and badge-bar, and grille.

I removed the air-cleaners, carbs and inlet manifold. On the bench the inlets of the carbs are uppermost, so they are plugged with a twist of clean paper. The crankcase ventilation hoses are removed, the fuel supply and servo hoses are tucked out of the way as well as the disconnected accelerator and choke cables. For the choke rather than undoing the inner clamp screw on the front air-cleaner bracket, which makes it a right fiddle getting the splayed strands of the inner back through the trunnion hole, I pulled the split-pin and disconnected the outer from the choke interconnecting lever. I removed the near-side engine restraint bracket, which has the carb overflow pipes attached to it, as an assembly. I have a solenoid valve in the vacuum line from carb to distributor so that comes off with the tubes as an assembly.

I had thought about disconnecting the exhaust manifold from the head and with the front, middle and back supports slackened pulling it across to the side of the engine bay. I did that for the head gasket change, but looking closely it seemed it wouldn't give me much clearance if any to the flange at the bottom of the block, and I didn't want to make things any more difficult for myself than needed, so opted to remove the down-pipes from the manifold. A 3/8" socket on extensions and with a UJ reached all the nuts easily, and I was surprised at the good condition of nuts and studs, although they had been replaced when this manifold was fitted in the early 90s. However three studs came out with the nuts. Getting the down-pipes out of the manifold was another matter! I had to wedge a piece of timber across the top of the pipes and under the chassis rails, lift the engine until that bowed, then hammer down on first one pipe and then the other with another piece of timber and a lump hammer. But that couldn't be done until I had disconnected the engine mounts. Shortly afterwards I came across someone who had done it leaving the manifold on the down-pipes, which is definitely easier.

Removed the bottom hose from the radiator, with a large padded envelope under it to guide the coolant into a bucket rather than it going everywhere. Rather than pulling it off and everything rushing out, with the clamp slackened and pushed out of the way I wedge a screwdriver in the joint to create a small gap for it to trickle out, getting on with other things while it does so. Remove top and bottom hoses, and heater hoses - remember to open the heat valve when draining! Also the heater return tube from the rocker cover studs, just to get it out of the way.

Disconnected the oil gauge pipe from the block, then the cooler hoses from block and filter adapter, and remove the radiator, diaphragm and cooler as an assembly (over-slung cooler on CB may be OK, but you wouldn't want to hit it with the engine. Under-slung on RB can be left along with the diaphragm). Hoses need to be held up or positioned over containers to catch oil, and the filter adapter port needs to be plugged or a container positioned under it as unless you remove the filter first that will drip slowly but steadily the whole time. Plug and cover the oil connections on the block to stop anything falling in - I used the cut-off end of an old cooler hose and the old gauge hose.





Remove the temp sender from the head, removing the lower bolt from the heater tap to release the support bracket, and carefully tuck the capillary and bulb out of the way.

I had pondered leaving the starter on the engine, but it looked like it might foul the rack-shaft when pulling the engine back, so again opted to remove it to avoid making things more difficult than they need to be. That needs the distributor to be removed, which I do complete with clamp-plate, again plugging that hole. The bottom starter bolt needs a socket on an extension as the clutch hose is in the way, although you could disconnect that from the bell-housing first - however if the rubber dust-cover is loose that can get pushed off by the piston seal spring and all the fluid gush out. Top bolt is easy to access from above, then the starter can be pulled back and angled to lift out from above. This is with the inverted canister oil filter, the earlier suspended filter arrangement may be different.

Incidentally the two starter bolts are different on engines attached to 4-synch gearboxes. The upper one goes through the engine back-plate and into the bell-housing, so is longer. The lower goes into the back-plate only so is shorter. If a long bolt is fitted here it can foul the flywheel. However there is confusion over the thread type. The Parts Catalogue indicates they are both UNC thread; Brown & Gammons indicates they are both UNF; Moss Europe indicates the longer upper is UNC and the shorter lower is UNF. Moss makes the most sense - bolts that go into alloy castings are usually UNC, and those that go into steel are UNF.

Alternator has to be removed to get at the off-side engine mounting nuts and bolts. Annoyingly, a couple of the nuts and bolts are non-standard and fractionally bigger across the flats, so my 1/2" ring spanners won't fit, and the open ends have to be wiggled on and off. There is often a spacer plate under the near-side mount - don't lose it!

Just the bell-housing bolts left. I remove the top, upper side (the upper starter bolt also acts as the upper off-side bell-housing connection) and lower side nuts leaving the bolts in place to act as guides, and leaving the lower nuts until last. As you are lifting the engine initially with the gearbox attached to get the gearbox to the top of the tunnel, these are all that are required to keep the two halves together.

Incidentally all bolts removed from tapped holes, and nuts from studs go back in and on so they don't get lost or mixed up. That pretty-much leaves just the engine mount nuts, washers and bolts to be fitted together and those and the bell-housing nuts and washers to be kept in a safe place.

Now ready for the main lift. The front mountings come free with a bit of a bang, and I lift until the bell-housing reaches the top of the tunnel. Once there I jack under the bottom of the bell-housing to keep it wedged up there, and the lower bell-housing nuts can be removed, again leaving the bolts in place to act as guides.

Which leaves the separate. Pull the engine back, only to find that the sump hits the cross-member before the end of the first-motion shaft clears the cover plate, so I can't lift it straight up, which didn't happen with the rubber bumper. Don't think about it too much at the time, and lifting and wiggling does eventually get the engine up and out, pulled forward clear of the front of the car, and lowered onto my saw-horse for additional support. (Subsequently asked someone else who had just pulled a CB engine without mentioning this problem, and he said he had the same thing. I wonder why no-one has every seen fit (in my sight) to mention this before). While doing that the pilot bearing came out of the crankshaft, which I wasn't expecting, normally people have to resort to some quite ingenious methods if changing that with the clutch. Personally I don't think it should be necessary, the only time that bearing is getting any wear is when you are in gear with the engine running and the clutch is fully or partially disengaged.

First sight of the release bearing and cover plate - and it is shocking! Bearing completely knackered with balls jammed and them and the housing ground down, the boss on the cover plate practically worn right through, and the ends of the diaphragm springs showing blue from excessive heat, and some partially cut through from the outer corners of the release bearing fork. No-one could accuse me of not getting the maximum life out of it! The air-gun gets the cover-plate bolts undone without having to jam the crankshaft in some way, to reveal the friction plate, which is barely worn. If it hadn't been for that damned release bearing the clutch itself would almost certainly have lasted another 50k and 15 years or so. The flywheel does have a slight wear groove, from a previous friction plate having worn down to the rivets, but as it's been like that for the past 22 years I'll leave it as it is, not worth removing it and getting it skimmed. The inside of the bell-housing is well mucky of course, but dull dry dirt rather than the shiny wet-look of the previous two, so again I just check the gearbox front-cover nuts for tightness.

The other thing I notice is how offset the release bearing is to the first-motion shaft - sideways relative to the orientation of the release arm pivot bolt, getting on for 3/16". Even with the bearing removed the forks are still offset, and removing the arm and turning it over is just the same. I.e. it isn't the arm that is bent, but the pivot bolt bracket is not in line with the shaft. That's almost certainly what has caused the roller bearing to fail, which is why John Twist says roller bearings have a high rate of premature failure when used on a gearbox not designed for them. OEM applications like the Midget 1500, MGB GT V8 and modern cars, have a special carrier that keeps the bearing concentric with the shaft, compensating for any misalignment between arm and shaft.

Not surprisingly I'm going to be using a standard graphite bearing this time, which are better able to cope with misalignment. However as the previous clutch replacement was caused by the release bearing casting wearing away and breaking, I'm wondering if the misalignment is so bad it caused that to fail, and so will cause the new bearing to fail. I find that with the pivot bolt nut slackened there is quite a bit of free-play between arm and bracket, and that tightening the nut would remove that free play to the point of the arm binding in the bracket, which was obviously too much. Adjusting the free-play in this way improved the alignment of the release forks to the shaft, but not enough to get an equal gap both sides. Note that this can only be done on CB gearboxes, RB gearboxes use a shouldered bolt which can only be tightened so far, leaving whatever free-play that exists between the brackets or in the bushing as slop.

Pondering some time, I decide to grind away the boss on one side of the pivot point of the arm, and fit a spacer washer underneath. But before removing the arm I remove the clevis pin between it and the push-rod, and the slave promptly evacuates its boot, piston, seal, seal spreader and spring and all its fluid ... onto the floor before I can get a container underneath it. The garage floor is painted concrete, and hydraulic fluid makes an excellent remover of that as well as cellulose! Modifying the arm probably takes most of a day grinding, flatting, checking the thickness with a dial caliper at six points around the pivot bolt hole, and trial fitting with a 0.2" washer. I'd previously ordered a new bush and pivot bolt in case the old ones were well worn, but to be honest there didn't seem much difference. Nevertheless I used them, driving the old bush out with the double-socket technique in a vice, and pressing the new one in with the bolt. Of course the new bush was now longer than thickness of the arm, so I opened up the hole in the spacer washer to fit over the protruding end of the bush rather than grind it off. It made refitting the arm much easier, than trying to line up the holes in the washer and the bush to get the bolt through. Finally I tightened the pivot bolt nut to bring the





new release bearing into concentricity with the shaft, as judged by the shank of a 8mm (I think) drill bit which just fitted into both sides, checking that the arm was free over its full travel. Note that as the release arm is moved back and fore the alignment of bearing to shaft varies in a longitudinal direction i.e. in line with the arm, there is nothing you can do about that. However - it was only subsequently that I realised if I had done nothing, and simply put a new release bearing and clutch in and they lasted the same as before, I would probably be over 90 before it needed doing again! Oh well, it's done now.

I'd contemplated tidying up the engine bay while the engine was out, but whilst I could have done the sides the back is so bad that short of removing everything it wouldn't have been worth it, so I left it. I could also have painted the radiator and diaphragm ... but where do you stop? (see 'Shipwright's disease'). However I did decide to clean the engine, as that was very dirty with thick crud from oil leaks having absorbed dirt. I couldn't do a proper job with my tow-rope still on, so I replaced that with the leveller attached to the rocker cover studs. I also removed the exhaust manifold to give better access. Engine cleaning probably took a day scraping, spraying with engine degreaser, working it with a brush, and wiping off. I couldn't pressure wash it in the garage, so laid a sizable sheet of plastic DPC down, put a grow-bag tray (without drainage holes!) on top of that, then an old cake tin in that to catch as much of the crud and fluids as possible. I'd previously spent some time sealing the rocker cover, and also replacing the side cover gaskets and seals, cleaning around those areas at the time, and they had stayed clean so hopefully they were now leak free. The gunge looked a little shiny under the mechanical oil pump blanking plate, so I took that off and made a new gasket - the original looked to be paper. The near-side engine mount needs to be removed to properly clean that side, but the off-side doesn't obstruct. The off-side was so mucky I couldn't tell what had been leaking, although having previously replaced cooler and gauge pipes I was pretty sure they were sealed. Which left the distributor - of which more later. I covered that hole - already stuffed with paper - with duck-tape to keep displaced crud and degreaser out. Whilst scraping the side of the engine back-plate that faces the sump, on the distributor side, some large lumps of what initially looked like underseal came off. Then I noticed it had revealed a large flat metal washer, and it turned out to be a very large grommet (12H 541) in a hole in the back-plate, the reason for which (the hole) can only be guessed at. That'll have to be replaced, so goes on a list in case I find anything else along the way.

With the manifold off I refit the three studs that came out on exhaust removal. Clamping them in a large vice I got the nuts loose, then with double-nuts could tighten the studs back into the manifold.

With the engine clean I can fit the new clutch! I check the friction plate fits the splines on the first-motion shaft. I also check the fit of the dislodged pilot bearing on the plain end of the shaft, it's not overly sloppy, so I refit it just tapping lightly with a suitable socket, whereupon it seems firm enough. Offer-up the friction plate on the alignment tool, checking that it is the right way round (friction plate butts up to flywheel, the wrong way round there is a big gap between the two), and loosely fit the cover-plate bolts. I'll need to hold the crankshaft still to torque up the cover-plate bolts, but a 1 5/16" socket fits the crank pulley nut well enough even with the lock-tab still in place, with a short breaker bar in that resting against the side of the sawhorse. Tighten and torque up bit-by-bit and evenly to 25-30 ft lb. As I do so I continually check the alignment tool is free in the friction-plate, if the friction-plate is fractionally off-set as you start to tighten the cover-plate bolts, it can wedge the alignment tool between the pilot bearing and the splines, which makes it difficult if not impossible to pull out. If it moves freely with the cover-plate fully tightened, then so should the first-motion shaft.

Clean the very mucky starter motor and its cable/wiring, and the not so bad alternator.

I'm changing the clutch slave and flex hose as a precaution. In 2008 we didn't bother but after the disturbance the slave weeped and was impossible to bleed. In the end we changed it and had planned to change the flex, but with the engine back in just could not get the pipe and chassis bracket nuts undone. So we had to reuse the old hose, but the new slave had a different thread start position to the old which meant that when tightened the slave wouldn't sit against the bell-housing without putting a twist in the hose. Fortunately an extra copper washer at the slave end brought it into alignment. I've opted for a braided hose, as for years and particularly when changing the master seals two years ago I ended up with a low biting point despite repeated bleeding using various techniques, and wondered whether hose swelling was a contributory factor. First thing is to undo the slave bolts - and they are tight all the way. They are also different to each other - one 1/2" with an integral washer, the other 15mm. When I get them both out I can also see the threads are different, so one of them has been forced in - presumably at a previous slave change as I can't imagine it being done like that from the factory. The bolts were quite rusty and cruddy, so I ran a hacksaw blade along both faces of the threads for the full length to clean them up. I wondered about using a tap to clean up the bell-housing threads, but didn't want to remove any metal, and in any case didn't have one that fitted either of the bolts so that was that.

Whether it was ease of access with the engine out, or they weren't that bad anyway, the pipe and hose nuts came undone easily enough, and the shiny bits go on. Screw the hose into the slave first, attach the slave to the bell-housing copper-greasing the threads, and making sure they go back in the same positions. Oddly the 15mm bolt goes in quite easily now, but the 1/2" one is still stiff. Then I can tighten the hose in the slave, and fit the hose to the pipe and chassis bracket, and refit the push-rod and clevis pin. The first thing I notice is that the wear in the clevis pin - which I had noticed earlier but ignored as the hydraulics compensate for any wear at that end (unlike wear at the top end which leads to a low biting-point). The pin didn't look too bad when out, but with the corresponding wear that must be in the end of the release arm the two are way out of line and looks really bad, so another part to go on another list, together with a release arm gaiter, as I've already ordered the engine back-plate grommet.

Then I notice that having raised the release arm on its pivot bolt by 0.2", the slave is not directly in line with it anymore - buggah! What to do? Put the release arm back in its original position by putting the washer on the ground down side? Which leaves the original misalignment and possible future release bearing problems? So I decide to modify the slave. It's alloy i.e. quite soft, so I opt to overdrill and file the holes somewhat in order to slide it across to closer alignment. It does mean that one has to hold the slave in the correct alignment while tightening the bolts, but it's not something I'm planning on doing again for a while yet ...

The engine back-plate grommet has arrived, I thought it might be a bit of a struggle sandwiched in the narrow gap between that and the sump, but it pops in quite easily. With that, the engine is ready to go back in.

I've already lubricated the release bearing pivots with the red grease supplied with the clutch kit, so apply more to the splined and plain part of the first-motion shaft, and the splines of the friction plate and pilot bearing. As I have removed the tow-rope from the engine for cleaning, if I refitted it for lifting I could no longer rely on it holding the engine at the correct tilt for the gearbox. But this time I have the leveller, so decide to use that. However that adds many inches to the distance between the arm and the top of the engine, which means the arm has to be raised higher, which means the reach into the engine bay won't be as much, and may reach the ceiling before the engine is high enough to clear the slam panel. I could lower the front of the car by taking it off the ramps, but that compromises getting at particularly the lower bell-housing bolts. I shorten the two chains on the leveller, and the one between the arm and the hook by as much as I can, and I do have enough lift to clear the slam-panel and ceiling at least, and push the hoist with engine forwards, lowering as I go, in small increments as the





cover plate gets closer to the end of the first-motion shaft. The leveller also proves its worth to get the correct tilt, although as you vary the tilt you are also varying the fore and aft position of the engine, so all that has to be taken into account to avoid hitting the shaft. Also although you can move the pump-end of the hoist from side to side, because the arm is at its fullest extent, the engine is very close to the wheels on the legs, so the engine itself hardly moves from side to side. So if the leg wheels aren't in the right place, you have to back out, slide the pump-end across, and push back in. And then comes the problem.

Although I have the engine correctly positioned, when I try to lower the cover-plate past the end of the first-motion shaft, the front of the sump hits the cross-member first, which pushes the engine back, until the cover-plate is overlapping the end of the shaft. I suddenly realise this is the same problem Terry had. It wasn't a case of the pulley fouling the rack as I thought then because with the gearbox raised that is well clear. Fortunately the suggestions I made of moving the gearbox cross-member back and only putting the bolts back in the minimum amount to give more tilt did help, but Terry's still needed a shove to get them together. I didn't have this problem with the rubber bumper, then it struck me that they have the body raised on the modified cross-member, which means the gearbox when at the top of the tunnel will also be raised relative to the cross-member, and maybe that gives just enough clearance for the engine to be lowered all the way down before the push back.

However with the leveller I can over-tilt the engine i.e. clutch end down, till the cover-plate can go over the end of the shaft while the sump is still clear of the cross-member, which allows the engine to go back an inch or so, which gives more clearance between the front of the sump and the cross-member. I adjust the leveller, arm height and hoist position bit by bit in concert, sort of swooping the engine down, back and onto the shaft, until the engine is correctly aligned with the gearbox in terms of the shaft being in the middle of the cover-plate hole and there being the same gap all the way round between the engine and the bell-housing. I've got the gearbox in 4th so the shaft won't turn, and pushing back on the engine and with the pulley socket back on the nut turning the crank back and fore, the splines engage quite easily. Push back further and wiggle the engine so I can get the bell-housing bolts in the back-plate holes. The top starter bolt helps keep the two halves aligned as it can be screwed on from the front while you get the bolts bell-housing bolts through the back-plate holes, and pushing back further allows me to start getting the nuts back on. I get to within about 1/4" but with the leveller and the higher angle of the arm the hoist is as far back as it will go with the pump up against the front of the car. So with a combination of wedging a piece of wood between the pulley and the rack tube, and tightening the nuts bit by bit, I pull the two together. In hindsight if I had left the back chain on the leveller one link longer, I would have had to wind the leveller to move the engine forwards to get the correct tilt, which may have brought the two fully together. However that may have then compromised my ability to get the back of the engine raised enough to 'swoop' the engine onto the shaft.

With all nuts fitted and the bottom two tightened, I can remove the gearbox jack and lower the engine onto its mounts - phew! 'Just' the reassembly to go.

First is to get the top two engine mount bolts each side in. These go head up, thread down. Even though it is easier to get the nuts on the other way up, the excess thread sticking up compromises alternator adjustment on the off-side as well as the fitting of the restraint plate on the near-side. Remember to refit the spacer plate under the mount on the near-side. A bit of lifting and wiggling with just the bolts pushed through may be needed to get them all in, before you can fully lower and start fitting lock-washers and nuts, tightening them while you still have maximum access.

The exhaust was slightly fiddly, the clamping plates had slid down and I couldn't get the front one up past the sump flange. I couldn't pull the pipes sideways enough to get it past as the pipes were fouling the studs, so had to completely disconnect the front mount to bell-housing so I could push the pipes down, then sideways, then slide the front clamp-plate up. With the exhaust released that stayed there and I could get a couple of nuts started, and I could slide the back one up and get a couple of nuts on that as well. The ends of the pipes wouldn't go up into the manifold initially, and needed pulling and pushing back and fore and sideways. Then I could get all the nuts on and tighten them.

After that it is a case of refitting everything else, in reverse order. Well I say 'everything', but I wanted the minimum back on so I could run the engine and check the clutch before I went too far, discovered a problem, and had to remove it all again so wouldn't be putting the hoses or coolant back, connecting the heater valve, temp sender etc. So carbs, choke and accelerator cables, fuel pipes, crankcase breather and servo hose go back on. On the other side refit the starter and its cables/wiring. Then the oil cooler (and hence the radiator and diaphragm just loosely attached and the cooler resting on the apron) and gauge pipes, distributor static timed to 10 degrees, cap and plug leads. Then the dreaded clutch hydraulics filling/bleeding!

As the car was on its front wheels on ramps reverse bleeding from the caliper wasn't initially an option, so I went for conventional bleeding from the top with the Eezi-Bleed. Pedal felt very light, with a 'dead' area near the top, so probably still air in there which didn't surprise me. I checked the push-rod travel by measuring from a flange on the master to the furthest edge of the release arm - first with the clutch pedal released and then with it wedged fully down ... and got 11mm or 7/16", which is less than the 1/2" I've always considered the minimum. Nevertheless I started her up, tentatively checked reverse and got grinding. Wasn't that surprised, but could select 4th, and whilst the biting point was low it wasn't that much lower than before, so rather bothered by the grinding. Switched off, and as it was near the end of the day wedged the clutch pedal fully down overnight.

Next day released the clutch pedal hoping to flush any air back into the reservoir, but travel just the same, with the same grinding and biting point as before. Buggah. It all gets a bit confused now, but by supporting the off-side spring-pan on an axle stand I can get the wheel off for reverse bleeding, and it is no better. Intending to drain only some out it took me by surprise and emptied, but then I've filled a completely dry system this way on the V8 and had a full clutch straight away. Move on to plan C and take the slave off letting it hang on the hose, and with a cross-point screw driver force the piston all the way in as far as it will go, with significant gurgling up at the master at one point which is promising. Refit the slave - aligning it to the release arm as before. Check the travel as before i.e. fully wedged down and fully up and still 11mm. Run the engine again and reverse still grinding, but paradoxically the biting point is now a lot higher. Double-bugger, the friction plate must be dragging on the flywheel or the pressure plate, or the first-motion shaft binding in the pilot bearing. I could take the engine out again, but what would I be looking for? Without mating it up to a bell-housing with a great hole in it I wouldn't be able to check anything. Eventually I decide to complete the job, and see what it is like on the road. One thing I had discovered along the way is that if I nudge it into first before selecting reverse, it goes in with just a slight crunch not the full grind. Also only partially operating the clutch pedal, or waiting with the pedal fully down before selecting reverse, makes no difference.

So fit the rest of the stuff except for bonnet (fitted with the Navigator who is always happy to help with 'clean' jobs), bumper and grille, fill with coolant, and take it up and down the road. Idle was very rough and lumpy, so check the setup to find the air-flow balance very close but the mixtures on both carbs needed richening by several flats for some reason - I'll check it again after some shake-down mileage. Biting point is very high - uncomfortably so, probably due to my extended master push-rod I fitted in 2014 in an attempt (only partially successful) to raise the biting point when I had all the problems bleeding after changing the master seals two years ago. Still crunching into reverse, reduced by nudging into first immediately





beforehand, so I'll just have to get used to doing that every time, until I can see if it 'beds in'. Leave the pedal wedged down for another night - next morning no different.

Finally fit the bonnet, bumper and grille and take it for a few miles. It's so annoying, the new clutch is beautifully smooth and light, and no judder in reverse that the previous clutch did from new, just that crunch engaging it, and the uncomfortably high biting point. Post 'finally' I take out the extended push rod which lowers the biting point to a more comfortable level. I recheck the slave piston travel and it is still 11/12mm (but then so is the V8 checked at the same time), so I just can't understand why getting-on for an inch difference at the pedal isn't more visible at the slave. Swapping the cars round for these latest checks the roadster went into reverse with just a click, but then swapping them back it was more like a crunch again. So maybe it will get better with time ... or maybe not.

Post post 'finally', I get a free clutch pedal, with that fitted it should be back to standard. Well it certainly improved things, but still seems higher then the V8, but as pedal, piston and master-pushrod are all now as standard I'm not going to do any more with it.

Having cleaned the engine I've been looking carefully all round to see if I can see any oil escaping, and did see a small trickle under the distributor. Originally engines for Mk1 cars had an O-ring on the distributor shaft, then it was deleted for the rest of chrome bumper production, only to reappear again for rubber bumper cars which had the 45D4 distributor. Although the distributor for this engine wouldn't originally have had an O-ring, or even a slot for it, I decided to buy one to see if I could make use of it. On removing the distributor I was surprised to find a slot, then remembered this was a remanufactured unit and not an original. So O-ring fitted. However the block face the distributor clamp plate butts up to seemed clean, and there are a couple of plugged oil-ways immediately below that so it could be from there. But after a few dozen miles there is no sign of more oil, so O-ring it was.

## Flex Hose

Came across an interesting snippet in the July issue of Enjoying MG. Someone touring Iceland had a persistent starting problem that was diagnosed as a 'lazy starter'. Subsequently the clutch flex hose split, which was of the braided steel type. It was only after replacing that with a conventional hose, when the starting problem got much worse, that they realised the gearbox earth strap hadn't been reconnected after clutch work and the starter had been earthing via the clutch hose! This caused lots of heat which eventually caused the rubber inner to fail.

Now quite apart from the fact that steel braided brake hoses are one thing (the pressures in the clutch hydraulics simply shouldn't need it the same kind of resistance to ballooning) if the person doing the initial starting problem diagnosis had done a proper volt-drop test on the starter it should have been immediately obvious there was an engine/gearbox earth strap problem.

There is also a point of view that says steel braided brake hoses are dangerous unless changed on a routine basis irrespective of mileage and condition. The normal reason for replacement of non-braided types is fine cracks developing in the outer covering, which occurs well before the hose becomes dangerous. With steel braid covering you can't see the condition of the rubber, hence the need for routine replacement regardless of condition.

As I relate above to remove the flex hose from the slave you must undo the pipe nut that connects the end of the steel pipe to the top of the hose, then undo the large nut securing the hose to the bracket, both of which are well concealed above the bracket with poor access when the engine is in. Although they are standard sizes you really need the special spanner for the pipe nut that is like a ring spanner with a slot cut in it for the pipe to pass through as it will grip much better than a standard open-ended. Only when the hose is at the very least loose in both places will you then be able to remove the hose from the slave cylinder. The alternative, which is much easier if all you need is access to the slave, is to disconnect the clevis pin on the slave push-rod, **slacken** the hose in the slave, remove the slave mounting bolts, then unscrew the slave from the hose. Refitting is the reverse of removal, but be aware that the start for the hose thread in a **different** slave will almost certainly be in a different place in the slave casting, which means the hose is almost certainly bound to be twisted when fully tightened and the slave remounted - which isn't acceptable. You **may** be able to get away with extra copper washers to pad it out, but maybe not.

*June 2013:* Did a precautionary change of clutch slave and flex hose while the engine and gearbox were out for an OD replacement. The usual odd sizes of nut on pipe and hose, plus hex on the hose, but Whitworth spanners fitted both on the old hose, but only one of them on the new!

## Fluid

No reason not to use the same fluid as in the brakes, so see here.

## How It Works *June 2013*

It took me years to work out how a clutch works, and someone else recently asked me, so here goes.

At its simplest level, imagine a circular ham sandwich. One slice of bread represents the flywheel, the ham represents the friction plate which is attached to the gearbox input shaft (first-motion shaft), and the other slice of bread represents the pressure plate that is part of the cover plate assembly that is attached to the flywheel. The two slices of bread are attached together in that as one turns the other turns, but the one representing the pressure plate can move in and out relative to the other one.

When the two slices of bread are pressed together, trapping the ham, all three rotate as one unit, and this is when drive is transmitted from the engine to the gearbox and thence the rear wheels, or vice-versa on the overrun - clutch engaged.

When the slice of bread representing the pressure plate is pulled back a little, i.e. when the clutch pedal is depressed, the ham is released, and the two slices of bread rotate independently of the ham. This is what is happening whenever the clutch pedal is depressed, regardless of whether the gearbox is in gear or not, the engine is running or not, and the car is moving or not - clutch disengaged.

So much for an analogy, now for the actuality.

A clutch kit consists of a friction plate, a cover plate assembly, and a release bearing. The cover plate assembly is bolted to the flywheel and consists of the cover plate, pressure plate, diaphragm spring (a set of flat fingers radiating out from the centre of the cover plate) and a release ring which is attached to the inner part of the diaphragm spring fingers. The pressure plate rotates with the cover plate, but is free to move towards and away from the flywheel under the control of the diaphragm spring and the release bearing. The friction plate is fitted between the pressure plate and the flywheel, is keyed to the gearbox shaft on a set of splines so rotates with that shaft, and is free to move back and fore along the splines.

With the clutch pedal released and the cover plate bolted up to the flywheel, the diaphragm spring squeezes the friction plate between the pressure plate and the flywheel, and in this situation the flywheel, friction plate, pressure plate and cover





plate rotate as one and motion is transmitted from the engine to the gearbox, and vice-versa - clutch engaged.

When the clutch pedal is depressed the mechanical and hydraulic linkages of the master and slave cylinders and the release arm push the release bearing against the release ring. The release ring is attached to the inner ends of the diaphragm spring fingers, and the fingers pivot on the cover plate near their middle. So as the release ring and inner part of the fingers are pushed towards the flywheel by the action of the clutch pedal and release bearing, the outer part of the diaphragm spring fingers moves away from the flywheel, pulling the pressure plate with it. This releases the friction plate, which moves away from the flywheel slightly on its splines, and so rotates independently of the flywheel and cover plate assembly - clutch disengaged.

And that is basically it. There are additional niceties in that the friction plate has a set of springs between the splined socket and the disc that carries the friction material, to absorb any shocks and vibration as the clutch pedal is released. The end of the gearbox input shaft has a plain section, which fits into a hole in the end of the crankshaft. This hole has the pilot bearing pressed into it, the gearbox shaft is a clearance fit in the pilot bearing, which keeps the two shafts inline.

The release bearing can either consist of a 'carbon' (actually graphite) ring in a steel casting (standard MGB 4-cylinder), the graphite ring rubbing on the release ring as the cover plate rotates, or it can be a roller bearing (standard V8, optional 4-cylinder) which has two halves - an outer that rotates with the cover plate, and an inner that is fixed, roller bearings taking the movement between the two. graphite bearings continuously wear down, but in normal and correct use should last the life of the friction plate. Roller bearings are supposed to avoid this wear, but some people say they need a pull-off spring so the rollers aren't continually spinning, and the clutch kit for the V8 comes with a new roller-bearing release bearing anyway! Roller bearings are available as an option for the 4-cylinder, but in my opinion they simply aren't necessary and are a waste of money, and can fail catastrophically in a relatively short period of time.

People worry about wear on the pilot bearing and talk about changing it as part of a clutch replacement. But if you think about it the only time the shaft rotates in the bearing is when the clutch pedal is depressed, which is a relatively short time (or should be!) in the life of the car. People also talk about changing the crankshaft oil seal and the gearbox first motion shaft oil seal as part of a clutch change. Fair enough if they are leaking, but if they are not then they are probably best left alone. The more things you fiddle with the more you are likely to disturb something else. It's a balance between the disturbance of changing just the clutch causing an existing seal to start leaking, or a replacement component disturbing something else, being faulty to start with, or simply lasting a much shorter time than an original. Getting the engine out to replace a tuppenny-ha'ppeny seal is no trivial task, but I prefer to err on the side of "if it ain't broke don't fix it" rather than "shipwright's disease". Or maybe I'm just tight!

## Master Cylinder

Types
Bore Sizes
Repair Kits
Seal Replacement
Bleeding

Typical problems can be a low biting point, baulking when selecting a forward gear, grinding when selecting reverse, the car creeping forward with ever more urgency while the pedal is held fully down, fluid leaking down the pedal, or a slipping clutch. The first three can be caused by wear in the pedal to master cylinder linkages, too short a master pushrod or air in the hydraulics. The fourth by a faulty primary or pressure seal on the piston, the fifth by a faulty secondary seal, and the sixth by too long a master push-rod as well as a worn out clutch. A couple of diagrams may help to explain these:

Initial movement of the piston by the pedal pushes fluid up into the reservoir via the bypass hole and doesn't disengage the clutch. As soon as the primary seal covers the bypass hole further movement of the piston pressurises the fluid in the lines and starts disengaging the clutch. As the primary seal continues moving forward and clears the bypass hole fluid is free to run into the space behind it from the reservoir, the secondary seal prevents fluid leaking out the back of the master and down the pedal. If the primary seal is faulty pressurised fluid can leak back past it into the space between the two seals and back into the reservoir, which causes the clutch to progressively re-engage even though the pedal is fully down. A ripped seal may not pressurise the fluid to release the clutch at all, the pedal will be very light in this instance (which can also be caused by air in the hydraulics). If the secondary seal is faulty, fluid, even though it is not under pressure, will leak back towards the pedal linkage and run down the pedal.

The final problem happens when something prevents the piston coming back far enough for the primary seal to clear the bypass hole. Releasing the pedal should release the pressure, and any expansion or contraction of the fluid in the slave or pipes from heating or cooling while the clutch pedal is released flows via the master cylinder and the bypass hole to or from the reservoir as appropriate. The problem comes when the piston hasn't come back far enough for the primary seal to clear the bypass hole. If the fluid should heat up and expand in this instance it can't flow into the reservoir as it should, so the fluid pressurises which tends to release the clutch which can cause slipping at high loads in 4th. This can be caused if a master push-rod that is too long has been used, or some other problem is preventing the pedal coming all the way back. A similar thing can happen if the slave hose starts delaminating and acting as a one-way valve. The correct length push-rod, together with the master piston and pedal returning all the way, should put the holes in the end of the push-rod and the pedal in line so that the clevis pin can be slid in, and there should still be a little free play at the joint. If the pedal has to be pushed forwards to line up either the master piston isn't coming back far enough or the push-rod is too short. If the piston has to be pushed into the cylinder form them to line up either the pedal isn't coming back far enough or the push-rod is too long.

**Types** *Added January 2010*

Originally part number AHH 6553 with a metal cap on 3-synch cars, it was changed to BHA 4667 on Mk2 cars. This had the reservoir canted over slightly to give better clearance to the early North American dual brake master but was fitted to all cars. Probably got the plastic cap about this time.

There was a third variant AAU7152 interchangeable with the previous type, this has different internal components which has to be considered when buying repair kits. Clausager says the change was "probably sometime during 1973", and is denoted by 'Identified with two concentric rings' in the parts catalogue, and by this drawing on the Moss Europe site. However that drawing shows two rings near the flange, and what looks like a letter 'O' at the port end. That puzzled me, since although my 72-built roadster has no markings (as one would expect) my 75-built V8 only has one groove near the flange on each cylinder, and nothing (that I can see in-situ) at the other end. It was only when I read this on the Moss US site: "Cylinder body is marked with two





concentric circles at end or grooved by flange" that it became clear that the Moss Europe drawing is wrong, showing two **parallel** rings near the flange, and what looks like the letter 'O' is in fact the two concentric rings referred to by BL and others. Brown & Gammons also appears to show two parallel rings or grooves at the flange end.

AHH6553 is quoted as being available from some sources but is confused by it being specified for 4-synch/Mk2 cars. Others quote it correctly for Mk1 cars, but show it with a plastic reservoir. Or show it as available with metal reservoir, and say it is AHH6553A that is not available. The replacement for all of them (AAU7152 isn't even mentioned by the main suppliers) is GMC 1007. For a long time this had a cylindrical plastic reservoir and what looks like a standard cap, and many suppliers still have this, but at the time of writing (August 2015) Leacy and Brown & Gammons have new remanufactured stock with the original metal can reservoir. When phoning both thought they were plastic, but when they checked the stock were able to confirm they were metal.

However some suppliers seem to have different versions with a large black cap which fouls the brake master - with the American early i.e. unboosted dual brake masters at any rate. One of these has a plastic reservoir but with the other it is part of the cylinder casting. Moss Europe has three types - the correct early type, specifying GMC1007 for the Mk2 version as well as a cheaper repro. Moss America uses it's own part numbers so you can't tell what you're getting, but they also have three types so I'm guessing they are the same as Moss Europe and their 180-695 is the GMC 1007 (even though it only says 'plastic cap'). The repro from both sources could be the one with the large black cap. Victoria British are showing part number 7-512 for Mark II cars with a plastic reservoir and a large plastic cap, which almost certainly is the one causing the problem. However the large cap seems OK with the later boosted dual masters which give more clearance.

The V8 item was originally BHA 5217, the same appearance as the Mk2 4-cylinder item but a smaller bore. The current replacement seems to be GMC 1011, which has a square plastic reservoir with what looks to be a different cap. However there have been reports that GMC1011 is too tall to fit into the space available, or if it **does** fit you can't get the cap off, unless you turn the reservoir round before fitting! These reports date from 2006, several MG suppliers do currently (2011) specify this master, so maybe the problem has been resolved. Hans Duinhoven has recently installed one of these and space doesn't seem to be an issue, even on an LHD where the clutch master is closer to the 'corner' of the engine bay than on RHD.

**Repair kits:**

Be careful when buying these. With three original masters plus three different types of replacement to a different external design and construction, there are at least two designs of internal components. For the pre-73 master there are two kits - one that contains just the seals where the main seal is the original cup-type, and the other containing all the internals where both seals are ring-type. This is actually a conversion kit to use the later seal type, but it does mean that if someone has previously fitted this conversion kit i.e. to a pre-73 master and you need to replace the seals, then you need the later kit as for the 73-on master cylinder. More info here.

**Seal replacement *August 2015*:** About 150 miles into a 520 miler for the Pendine Run I became aware the clutch pedal was occasional lighter than normal, and I was getting baulking. As it was intermittent I reckoned it was the main seal occasionally leaking back, i.e.

no fluid loss, and a check showed the level was normal. We completed the trip with no further drama, but I protected the clutch as much as I could by only changing gear when I had to, and if I had to come to a stop I only depressed the clutch pedal and engaged a gear when I was ready to move off.

On return home I investigated repair kits and replacements. The original style metal reservoir type are available again after plastic reservoirs having been the only type available for some years, but as previous master replacements had shown the bores with no visible scoring or corrosion, I decided to try a kit. That took quite a bit of sorting out as there are two types of internals, originally with different external markings, but the later internals are supplied as a kit for the earlier masters. This makes it effectively a conversion kit, but it isn't described as such, and means the original seals are no longer suitable. So with a car of unknown history you have to take out the piston to see what type of seals you have. Various suppliers reference this but I don't think they explain it clearly enough. Exactly the same applies to brake masters, but there is even less info from suppliers on those.

Bee's master does not have the later markings, and even though the clutch master hadn't been tampered with in my ownership of 26 years (and I suspect it was original to the car) I drained the system by opening the bleed nipple and pumping with the pedal and removed the piston and seals before ordering spares so I could check the bore. A long screwdriver is needed to get at the one cover fixing screw tucked down beside the inner wing, but a driver that takes hex bits with a couple of adapters and a 1/4" drive extension reached that OK, the others are easier. Cover twists out across the front of the masters towards the engine, with just the water bottle removed from its cradle to give a bit of slack on the tubing which normally sits over the flange of the cover. Split-pin and clevis pin removed, dust-cover pulled forwards, circlip pliers and a wiggle and pull removes the push-rod. The internal return spring pushes the end of the piston with the secondary seal out, pulled that the rest of the way out with my fingers, leaving the primary seal etc. still in the bore. Extra-long nosed pliers (from my BT days) tip the seal over so it can be gripped and pulled out. Peering into the bore I can see the plastic 'spreader' that sits between the end of the return spring and the fluid face of the seal has half a flange broken away so it had been at an angle on the spring and setting the seal at an angle. I can also see a broken piece of the spreader sitting in the bore. The seal itself it quite distorted, so must have been like that for a considerable time, amazing it kept going as long as it has. Fish the bit out and the spring with the remains of the spreader.

Wrap some hand-wipe cloth round a chop-stick (!) and uses that to wipe round the bore, which looks perfect. Because Bee's biting point has been rather low for as long I can remember, and I did modify the push-rod some years ago to give more 'throw' (which only improved things slightly), I decided to order both kits - the original at £4 and the conversion kit at £11. New spreaders not available, but having kept the guts of Bee's brake master and both masters off Vee changed some years ago, and out of those three two had the old-style seals with the same spreaders, so I had two spares!

Parts arrived from Moss next morning, and with the low biting point in mind and wondering if I would be able to improve it, I compared the lengths of the five pistons I now had - three previous replacements one with ring seals and the other two with cup, Bee's clutch with cup seal, and the new conversion kit with ring seal. They vary in length quite a bit, except that the new conversion piston is the exactly the same length as the previous replacement that has a ring seal, and Bee's piston is exactly the same as one of the old cup seal pistons. The remaining cup seal piston is slightly longer, and is my first though to fit, but when I check the diameter it is fractionally smaller than Bee's. That must be from the V8 clutch, which has a slightly smaller





bore than the 4-cylinder, so not a good idea to use. All the secondary seals are ring-type, but do vary in size.

Unlike the 4-cylinder the V8 clutch master did not change at any time, so it would be reasonable to expect that to have the cup seal as V8 production started before the 4-cylinder seal changed. Why the V8 didn't change in 1973 as Clausager estimates for the 4-cylinder is a bit of a mystery as the V8 still had a couple of years of production left. Maybe the change occurred after the end of V8 production. The other oddity is that of the other two previously removed pistons one is a cup seal the same length as Bee's, and the other is a ring seal the same length as the new conversion piston. One must have come from Vee's brake master, and the other from Bee's brake master, but (purely from an interest point of view) which came from which car? If the cup seal came from Bee, making both pistons and seals identical, then Vee must have had a ring-seal piston in the brake with a cup-type in the clutch. The Parts Catalogue has the same info about a change in brake master to one with two concentric rings as for the clutch, but is similarly vague about the date. And both Vee's brake and clutch masters only have one concentric ring, not two, Bee's having none. The brake master was always the same for the V8 and the equivalent era 4-cylinder. The implication is that one of the brake masters had already been modified with a conversion kit, but before my time. This is all rather by-the-by, and really only leaves me with two options - the new original cup-type seal with Bee's piston, or the new conversion kit, and I go for the former.

I coat the new secondary (ring-type) seal and the push-rod end of the piston with brake fluid, and ease the seal on easy enough. However there is a thin flange that projects forwards of the main part of the seal and sits flush against the piston body, that flange is partly tucked under the rest of the seal, and needs careful easing forwards with a small blunt screwdriver. After that one of my 'old' seal spreaders is fitted to Bee's spring and inserted into the bore, and the new main seal coated with fluid and manually pushed in. There is a curved thin steel shim that sits between the face of the piston and the back of the seal, which may push the seal away from the piston to open up the three holes in the face of the piston, which are perhaps there to aid fluid flow when bleeding. Insert the shim and the piston, and refit the pushrod with its thick integral washer and circlip.

For filling and bleeding I decide to try yet another variant of the reverse system I have used with complete success on Vee and a pals car. I connect a tube between the caliper and clutch nipples as before when I used the brake pedal and master to fill an empty clutch system, but this time I connected the Gunson's EeziBleed to the brake master. The same low pressure of about 15psi on the front off-side wheel I had removed to give me better access to the clutch slave, opened the clutch bleed nipple, then the brake, and fluid from the caliper fills the tube and starts going into the clutch system. Peer into the clutch master until I see fluid rising, then close the brake nipple. Test the clutch ... and absolutely no back-pressure at all, and peering underneath only a trace of movement of the push-rod. I'm pretty gobsmacked, as this method of reverse filling had worked perfectly the previous twice I had used it.

I tried operating the pedal slowly, some gurgling, but no change. So I wedged the pedal fully down over lunch, then slowly released it, no change. Someone recently said they pumped the pedal like mad, which also made no difference, except to obviously aerate the fluid in the master and make it milky. Next I wedged the pedal down, then opened the slave nipple, and quite a bit of air came out. Did that several times till no more air. I can feel some pressure now, but only about 3/8" of push-rod movement and it grinds if I try to put it into reverse. More pumping, still no better. So now I put the Gunsons on the clutch master and bleed normally, and loads of air and milky fluid comes out again. More pressure, but it still feels soft at the top and its still grinding. So I leave it wedged down overnight, hoping that the air bubbles coalesce, and can be pulled back into the master when I release it in the morning.

That makes the feel much better, it now engages reverse without grinding, although the biting point is very low at probably not much more than 1/4" off the floor.

Although the hydraulic system automatically compensates for all the expected wear at the clutch end i.e. in the release bearing (of which mine is a roller bearing anyway) and push-rod/clevis pin/release arm, I do wonder whether wear in the release arm pivot has allowed the arm to move outwards, so increasing the ratio of the arm, which would need more movement of the slave push-rod to get the correct movement of the release bearing. So I ease the push-rod into the slave a little to take the pressure off the release arm, and test for any wear in and out or up and down, but there is none.

I then start pondering all sorts of ways to get more throw on the pedal. Removing the (pretty thin) carpet from under the pedal makes no difference. So I modify one of my old push-rods to move the clevis pin hole as far as way from the master as possible. This moves the clutch pedal pad up from the brake pedal so does give more throw, but I'm surprised to find there is little change to the biting point. My dander is up now, so I also modify the pedal. I notice that the hole in the clutch pedal is about 1/8" lower than in the brake, so giving it a higher ratio. So as well as moving the clevis pin hole closer to the master, I also move it upwards, to lower the ratio and get more travel that way. I end up with the clutch foot-pad almost an inch higher than the brake, but still no damned improvement in the biting point! But when I check, I find that when the pedal when fully depressed it's about 1/2" off the carpet - because the clevis pin bracket on the push-rod is now pressed hard up against the dust-cover on the cylinder. The clutch is also very stiff, which surprises me as I wouldn't have thought changing the ratio would have affected it that much, but I discover that because I have moved the clevis pin upwards, the push-rod is now angled upwards instead of horizontal, and as the push rod moves in to the cylinder it also moves upwards, and is binding on its spacer behind the circlip in the cylinder. I then realise that the reason the clevis pin is that 1/8" lower on the clutch pedal, is because the clutch master is 1/8" lower in the mounting frame than the brake master is. This must have been done deliberately to get the right amount of movement of the slave push-rod, taking into account the relative dimensions of slave and master bore, without making the pedal pressure too high on the one hand (high ratio) or the pedal movement too long on the other (low ratio).

So that means I have to move the hole back down on the pedal to correct the angle of the push-rod, as well as move it away from the master a bit as there is no point in having the pedal pad so high that the master stops it way before it reaches the floor. But why is my biting point still so low? I take some comparative measurements with the V8, and whilst the V8 has more free play in the clevis pin linkage, it obviously starts to build pressure earlier than Bee. I then look again at the seal I removed from Bee, in conjunction with the older piston and seal, and realise that the seal I have just taken out is a good 1.8" deeper than an older cup seal. I didn't note the depth of the new seal that is now fitted, but if it is shorter than the one I have taken out then the seal will have to move further before it closes off the bypass port from the reservoir, which it has to do before it starts building pressure.

I could take the piston and seals out again, and perhaps fit the conversion kit, but that is also about 1/8" shorter than a piston with the original seal so isn't going to be any better. And after the problems with bleeding I'm not keen on having to go through it all over again. If I could put a spacer between the push-rod and the piston, then with the pedal fully released the piston would already be part operated, and if I could arrange for that position to be just short of closing the bypass port I would have maximum travel to pressurise the fluid.





There is a ball in the end of the push-rod that sits in a recess on the piston, presumably to avoid sideways forces on the piston as the angle of the push-rod changes slightly through its travel. I could wrap a spacer around the ball, but if that went behind the ball it would prevent the push-rod going fully back - reducing effective travel - as the back of the ball sits in a recess in the large washer. I could build up the ball with weld, but it would need to be carefully shaped back to a ball again, I don't have a Dremel, and I can't spin the push-rod so as to make sure it was circular. Which leaves a spacer disc of some kind that sits between the two halves.

But first I really need to find how far the piston needs to travel before it closes off the bypass hole. If my washer is too thick fluid expansion from heat won't be able to escape into the reservoir as it should, and I won't be able to bleed conventionally. By laying a ruler on top of the clevis pin bracket of the push-rod, and butted up against the open end of the cylinder, I see that the back of the bracket is 4.9mm (from memory) from the cylinder. Then I cut a fine wedge from a piece if hard board and fit it between the front of the pedal and the back of the hole in the bulkhead shelf that it passes through, so I can hold the pedal and hence the piston at various positions into the cylinder. Fully released I can push the slave push-rod and piston into the cylinder easily, and it moves out easily from the effects of its internal spring. 2mm of movement of the piston is the same, but 3mm makes it much harder to push in, and slower to come back out, so at 3mm the seal has partially closed off the bypass port. I settle for a 2mm spacer to allow for piston expansion when that gets hot, and find a washer that is slightly smaller than the cylinder bore, with a small hole in the middle, and a couple of mm thick. Clamping that in a vice between one of the old pistons and push-rods forms it nicely into a shape to fit between ball and socket. A trial fit in the cylinder does raise the biting point a little, not as much as I was hoping, but it seems to be the best I can get. It's effectively loose in the cylinder, so could get dislodged, but I realise that by putting a blob of weld in the hole in the middle of the washer onto the ball of the push-rod, and carefully filing smooth, overcomes the problem of getting the right shape as well as retaining it.

With that fitted the pedal feels much better, very little play at the pedal clevis, and it firms up sooner than before, but although the biting point has improved it is still lower than prior to the seal change. Maybe some air still in the system? I try wedging the pedal partially operated so it just closes the bypass hole, then using a big screwdriver in the release arm hole try to lever it forwards and push the piston into the cylinder but it doesn't budge. So I try another tip which is to push the slave push-rod and piston fully into the cylinder (pedal released now) and tie it there, initially as another way of seeing if there is air in the system, but also prior to another attempt at conventional bleeding. The pedal gets hard very quickly, no sponginess and I can see the release arm trying to move against the restraint of a cable-tie, so very unlikely to be significant air still in there. I reconnect the Gunson's to the clutch master again, open the bleed nipple and maybe a little does come out. Close and try twice more, maybe a couple of tiny bubbles. Once more and nothing. Once more for luck ... and disaster - the Gunson's bottle has emptied and pushed all the fluid out of the reservoir! If it hadn't been for that once more for luck I'd have got away with it. I'm running low on fresh fluid but put what I have in the Gunsons and fill and bleed again, the air bubbles are only reducing slowly, so it's down to Halfords for more supplies, and several more goes - keeping a close eye on the bottle! - before it's bubble free.

Try the clutch in reverse and really it's no better than its best previously. Wedging the pedal fully down and using dial calipers to measure the travel of the push-rod at 0.44", which I would have expected to be enough, especially as some have claimed theirs is only 3/8" (0.375") and fine. However with all the work I have done to increase the throw I would have expected it to be more than 'normal', which does indicate there is still a problem with the master ... or maybe the slave .. or maybe the bleeding. So it's still a mystery. Maybe it's something to do with the release bearing, but unless it is reducing in length as the clutch is disengaged, and I can't really see that happening. Maybe the friction plate is slightly warped, which means the pressure plate has to move further to completely release it. Possible, but I'm never one for engaging the clutch at high revs for a quick getaway, preferring to get it all in as soon as possible at little more than idle then using the torque to accelerate. That's something that will have to wait until the engine comes out, and would still happen even I had more slave piston travel than 'normal'. I could try the conversion kit, but going by the length of the piston from socket to seal lip that will be no better. It could be something to do with wear by the bypass hole meaning the seal has to move further to fully close it off, which would be corrected by a replacement master. For the time being I'm going to run with it, and see if I can live with it or not.

*July 2016:* Eventually I'm forced by release bearing problems to pull the engine and change the clutch, and after that I find the biting point uncomfortably high, even though the slave push-rod travel is fractionally less than before. I found that because of an alignment issue the release bearing is offset to the cover-plate by a significant amount, which basically means it has been pressing on one side harder than the other, which probably meant that the pressure plate wasn't moving away from the flywheel as much one side as the other, hence had to move further overall (lowering the biting point) to fully release the friction plate. So with the new clutch fitted I have to undo all the work I did to improve the biting point!

## Pedal Return Spring *Added May 2010*

Towards the end of the Wye Valley run this month there was a loud twang and something hit my foot, and looking down I could see one of the pedal return springs had broken. It's for the clutch (much more likely than the brake since the pedal goes down much further stretching the spring more, and may well be used more often anyway). This has happened before (albeit many years ago) and has happened exactly as before, which is near the bottom of one of the loops. As this is well away from where the spring contacts either the pedal or bracket I can only assume it is being twisted or bent back some how, rather than pivoting freely, so I'll have to look closely at how the replacement operates. Interestingly this time I couldn't tell from the pedals which one had broken as both were at or very near their fully returned positions. Last time was before I had taken the wear out of the pedal to master linkage and that was a good inch or more down without the spring. I opened out the last turn of the spring to make a new loop, but it was stretched quite a bit when fitted, so I opened out the spring bit by bit until it just returned the pedal all the way. It can go through the body tag in one of two ways, and attached the 'easy' way (hooked in from the more open tunnel side) it did seem to be bending the wire as the pedal was operated whereas inserted from the other side it moved smoothly in the hole, so that was the way I left it.

## Release Arm Gaiter

Two types over the life of the 4-cylinder MGB - an oval one on chrome bumpers (22H 1337) and a wider square one on rubber bumpers (22H 1693). However the Leyland Parts catalogue indicates (incorrectly) that the same one was used all through, and some suppliers get the change point wrong. V8s and I think the MGC had a circular one (22B 450).

By removing the gaiter and sliding it down the release arm it's just possible to see where the release bearing bears on the cover-plate, and hence estimate how much a graphite release bearing has worn.

## Release Bearing

**4-cylinder**
**Gauging wear**





**Roller bearing or plain?**
**V8**

*September 2009:* **Tip:** I've just read about a problem whereby someone was about to remove the engine to have a look at what almost certainly looked like a release bearing problem, but decided to try bleeding it instead, and seems to have solved it! He had just replaced the clutch but not the release bearing (and was roundly criticised for not doing so). For 20 miles it was OK, then started getting noise and vibration from the pedal when the clutch was pressed, and the biting point was very low. The opinion from several was that the release bearing was breaking up, which sounded like the cause of the noise and vibration to me as well having BT, DT. But I pointed out that if the clutch was otherwise still working that wouldn't account for the low biting point as the clutch is self-adjusting for any wear at the clutch end, and air in the hydraulics or possibly a problem in the mechanical linkages at the pedal end is the likely cause of that. I'd like to think it was that comment that led him to try bleeding first, and so far at least it seems to have been successful. Thinking about it afterwards the resistance to the flow of hydraulic fluid in the clutch system is quite marked, and a spring inside the slave piston is continually pushing the linkages that end together taking out any free play, being back-filled by fluid from the reservoir, so tending to resist any light movements of piston, release arm and release bearing. But get some air in the slave, say, and there is nothing to stop them rattling back and fore, so generating noise and vibration, just like air in a hydraulic suspension damper allows rapid movements of the wheel/axle instead of damped.

**4-cylinder:** The graphite (often erroneously called 'carbon') release bearing has a ring of graphite in a steel housing. When new the graphite ring when is 16mm thick, standing proud of the casting by 5mm, and in theory all this is available to wear down before replacement is required (see graphite bearing premature failure). But that is only if the release bearing is concentric with the pressure plate, as all but 5mm of the graphite is recessed into the housing. If the two are offset or the release arm is loose on its pivot the housing of the bearing will start rubbing on the pressure plate release ring, and that will wear down, probably accompanied by noise and vibration when the pedal is down, eventually to break up completely, which is what happened to Bee's in 1994 and also here.

Quite a number of people have said that depressing the clutch drags the idle down, something I've never noticed. However at the time I'd had roller bearings in both MGBs which maybe don't do it anyway. But after replacing the clutch (and using a standard graphite release bearing!) in July 2016 I deliberately looked for it and there is no apparent change in idle either on the tach or audibly. However shortly after I happened to notice the oil gauge flickering at idle (as many do), and also noticed that simply dipping the clutch was enough to stop it. Only a tiny change in conditions is usually needed to stop flickering of this type, and if I listened very carefully I could hear the tiniest change in engine note with the clutch down as compared to up. So yes, it does happen. But if very noticeable, especially if accompanied by roughness felt through the clutch pedal, or other noises, then it's a warning that the release bearing has reached the end of its life.

**Gauging wear:** When changing Bee's clutch I discovered that with the (oval) gaiter pulled out of the bell-housing and using a small very bright LED torch I could just see the release bearing pushed up against the pressure plate release ring. There was the matt light grey of the release bearing casting, the shiny steel of the ring on the pressure plate the bearing pushes against, and a narrow strip of dark grey between the two which is the graphite of the bearing. This should allow you to gauge the wear on the release bearing, and the larger gaiter on rubber-bumper bell-housings should make it easier. Whilst in theory the release ring on the cover plate should be able to wear down the graphite of the bearing to below the surface of the bearing casting as the ring is smaller than the graphite, in practice the less than perfect alignment of the two means that the bearing casting will almost certainly rub on the cover plate once the graphite has worn down flush with the casting. You won't quite see that point peering through the gaiter hole, but once the narrow strip of dark grey graphite is no longer visible, it will be getting close to worn out.

**graphite bearing premature failure**.

I've recently read about problems with graphite release bearings where the graphite ring disintegrates after only a short usage. The problem is said to have been caused by a change in manufacture from having the graphite ring bonded into the housing, to having it pinned. Relative movement between the two causes the graphite to crack around the pin and fall out. This seems to be what has happened to a fellow owner this week after only 8000 miles of use. However there were no pieces of graphite left in the housing or in the bell-housing, just a fine dust spread all around, indicating extreme wear rather than breaking up. There is a roll-pin in one side of the housing, is this the culprit? The good news is that a contact at the MGOC has confirmed that there **was** a problem, caused by pinning, but that current stock shows no sign of a roll-pin and seem to be OK in use. However these are Quinton-Hazell and not the Borg&Beck that failed here, who may still be using the roll-pin, so beware when buying either type. *June 2008* Bought a B&B clutch kit which included a bonded bearing, so B&B are OK too. However when I rang the supplier beforehand he said they had both types and I could have whichever I wanted. The one I got came boxed in a kit, so maybe it is the separate ones they have that are both pinned and bonded. I said to the counter person I wanted a bonded, and he said "you certainly wouldn't want a pinned" so he at least seemed to be aware of the problem.

*Update November 2008*

Another entrant for the chamber of horrors from Bob Muenchausen, although in this case it had done 75k over 17 years.

**Roller Bearings:** Updates: *July 2016*; *May 2016*; *April 2016*; *July 2014*; *Update 2004*; *November 2009*
I fitted a roller release bearing when I changed Bee's clutch in 1994 as it seemed a good idea at the time. Then I started reading about premature failure because the bearing is constantly spinning, unless a pull-off spring kit is fitted at the same time. Spoke to my supplier who said they had never heard of such a problem (well, they would say that, wouldn't they?). In fact the slave cylinder contains a spring that is continually pushing on the clutch arm to take up any mechanical play that may develop between clutch operations and so is pressing the release bearing against the cover plate. Presumably the pull-off spring is designed to be stronger than this, which will introduce a little play, and so also has a stop to control just how much play there is. Unfortunately this has the side effect of lowering the biting point, which may already be low to begin with if the pedal to master linkage is worn.

As time went by I realised how foolish I had been. Did I seriously think that I would leave an old bearing, roller or not, in the clutch the next time I changed it? Of course not. Do graphite throw-out bearings regularly and repeatedly fail before the clutch needs changing anyway? Not if you don't ride the clutch they don't.

Fast forward a couple of years, and I now have a wittering that sounds just like a dry bearing as the clutch pedal takes up the free play. Doesn't do it when the clutch is fully up or in the process of disengaging.





Would I fit another one? Would I 'eckerslike (i.e. NO!).

See also

this article from British Automotive.

*Update 2004:* 10 years later my own release bearing is still wittering, no worse, no better, so it looks like just one of those things. Despite my comment above about not using a roller bearing again I subsequently discovered the V8 uses them as standard, and so I believe does the Sherpa van and Midget 1500, so they can't be all bad (see this for why after-market have problems and OEM don't). And the V8 at least doesn't use a pull-off spring. I have a clutch replacement coming up soon on someone else's car and given the reports about the graphite bearings I **was** considering using a roller bearing again. However given that the after-market roller for the 4-cylinder doesn't seem to be available any more (and neither is the standard item for the V8 at the moment) and indications that the graphite is OK again, then I probably will stick with graphite.

*Update November 2009:* I've recently noticed that it has stopped 'wittering', how long for I don't know (see 'The dog that didn't bark' by Sherlock Holmes). Changes not being good, I hope it isn't an indication of impending complete failure. The roller bearings didn't seem to be available from the MGOC for many years, but they have recently started advertising them again. That, and experience of a number of people of the rapid break-up of graphite bearings does now leave me in a bit of a quandary - what to do next time, and if I decide to stay with a roller with my old one or a new?

*Update July 2014:* Whilst touring in Devon I suddenly realise the release bearing is making a rumbling squeaking sound when the clutch pedal is depressed, especially at first start each morning - not good so far from home! All through the travel this time, not just when fully depressed prior to release bearing failure back in 1994, and not just as it took up or released the pressure after fitting the new clutch and roller release bearing. It seems to get a bit quieter the more it is used, even while holding it down at the first start of the day, and the last time I went out in the car in early September I didn't notice it at all. Not looking forward to getting the engine out to change it again, after 'only' 50k albeit 20 years, but at least it would give me better access to the oil filter adapter sealing ring in the block that I need to replace, now I've replaced the adapter.

*Update April 2016:* The rumbling/squeaking has virtually stopped, but now the revs are dropping very noticeably with the clutch pedal down, something that has never happened before. So I suspect the bearing has now seized, and wearing both itself and the cover plate down! I'll have to keep an eye on the fluid level, and to monitor it I've fitted another cap with a float switch i.e. like I did for monitoring the brake fluid level, but instead of making another warning circuit I've simply moved the brake circuit plug over to the clutch cap, just as a temporary measure until I know what's happening.

*Update May 2016:* A thread is running on one of the fora, started by someone seeking advice on whether to use a plain or a roller bearing release bearing with a new clutch. As one would expect there are people swearing by rollers, and others (not just me) swearing at them. As far as I'm concerned having been bitten once I won't use one again. But take a step back, look at the bigger picture, and consider the tiny number of roller bearings that must have been fitted to MGBs compared with the massive number of graphite, and the almost universal use of graphite on most vehicles until relatively recently. Then consider the number of people complaining about rollers in MGBs, and the number complaining about graphite - which includes the special problem with pinned bearings a few years back. One has to conclude that roller bearings are exhibiting a far greater complaint rate compared to graphite.

**As to why rollers seem to be relatively poor on MGBs, when they are almost universal on modern cars now, plus the Midget 1500 and factory V8**, John Twist offers an explanation which is that OEM applications have a carrier which ensures the bearing is concentric with the shaft at all times whereas after-market don't. So where does that leave the people that say they have had no problems with rollers? John's explanation shows that the roller bearing is only concentric with the cover plate in one position of the release arm, and at all others it is non-concentric to a greater or lesser degree. When there is non concentricity, the release bearing is sliding back and fore across the face of the cover plate for every revolution of the engine, and that includes when the clutch pedal is fully up as well as when it is depressed by any amount. The graphite bearing copes with this sliding action just as well as it copes with the rotational action, but the roller bearing does not as it is designed to be concentric at all times, which it is in the Midget 1500 and V8. But John's demonstration of non-concentricity involved moving the release arm through its full travel, with no clutch fitted, and the push-rod end of the release arm is moving back and fore several inches. In practice the push-rod only moves about 1/2", and given the ratio of the release arm the release bearing will only be moving a small proportion of that, say about 1/8" to 3/16". If it happens to be concentric when the clutch is almost fully disengaged, then the unwanted sliding action either side of that will be minimal. But if it's not concentric anywhere in its travel, then the sliding action will be much more pronounced. That covers alignment in one direction - along the length of the arm - but there is also the question of horizontal alignment i.e. along a line between the release bearing pivots, which can have a far greater effect on non-concentricity. Some claim that roller bearings have a graphite face to deal with this sliding wear, which some may well do, but it seems daft to fit a roller bearing which needs a graphite face - especially when that graphite face is going to wear just as it does on plain bearings. Similarly some say they have fitted pull-off springs, but that removes the ability of the clutch system to automatically compensate for wear at the clutch end, and may need periodic readjustment.

*Update July 2016:* Since noticing the revs dropping every time I put the clutch pedal down I've been monitoring the fluid level which has needed frequent small top-ups i.e. wear is occurring inside the bell-housing. Then a few days before a trip to Cornwall I noticed fluid dripping from the slave, which is probably a sign that the piston and hence the seal has moved along the bore to a part not used before, which may be rough. So I don't think I can push it any more and I changed the clutch. Did I say wear? The condition of the bearing and the cover plate was pretty shocking.

**V8** - *Updated May 2016*:

The V8 uses a roller bearing as standard, but there is a self-centering function to keep it concentric with the first motion shaft and hence the cover plate, so the problem described above does not occur. The Parts catalogue lists this as GRB224, which at one point seems to have been NLA. However it comprises two parts which includes a carrier as well as the actual bearing, at which point it gets confusing. I was advised that as long as the carrier was sound it could be used with a replacement bearing, and was advised that this was GRB207. But GRB207 seems to be for the Midget 1500 and is completely different to the V8 Bearing I bought a couple of years ago. Furthermore my V8 bearing is quite different to the one shown by Rimmers, even though both are described as part GRB224. The Rimmers item seems to include an additional part which may be the carrier.

*October 2016:*





When Vee's engine and gearbox comes out for an engine rebuild and body restoration I get the full picture.

## Slave Cylinder *Added January 2009*



**General Description**

This is the very mucky 4-cylinder slave cylinder replaced as part of the clutch change above. Not only was the outer boot filled with fluid, but also black gunge and some crystalline substance as well. The outer boot with its clamping ring can be levered off the end of the cylinder, to reveal the outer end of the piston. As well as the large clamping ring on the outside of the boot which seals that from external dirt and moisture, there is a smaller square-section ring around the narrow internal tube of the boot which seals to the push-rod as well. The outward face of the piston has a conical depression to correctly position the push-rod. Although the central tube of the outer boot will locate the push-rod approximately centrally as it is inserted, if there were no other method of positioning the push-rod it would move about and probably slide to one side of the piston as any pressure is applied to it to operate the clutch. Not only would this distort the rubber boot and cause premature splitting and ingress of water and dirt, but it would cause rapid wear between the piston and cylinder wall, causing the piston to get 'cocked' in the bore more and more. This would also mean the hydraulic seal was no longer square to the bore, which would also reduce its effectiveness. The depression in the face of the piston means that as soon as any pressure is applied to the push-rod by the piston the push -rod is automatically positioned in the centre of the piston for best alignment and minimal wear.

Holding the cylinder upside down and tapping the edge of the cylinder at an angle should move the piston out of the bore until it can be gripped and pulled out the rest of the way. Behind the piston is the inner hydraulic seal - flat side facing outwards, cupped side towards the fluid, and behind that a locating disc on a spring. If gentle tapping fails to move the piston a thin steel rod could be inserted through the hose port and used to push the piston out. However if the piston is stuck the end of the rod will be bearing on the plastic disc that locates the hydraulic seal, so hitting or pressing on this too hard could distort the disc and so affect the seal in future. In the plastic disc there are three small holes to allow fluid through so that fluid pressure is applied to the seal itself to spread it and press the edges against the cylinder walls for a good seal.

The hydraulic seal is 'loose' in the cylinder (unlike rear brake slave seals which fit over the end of the piston and into a groove) and so are a doddle to remove and replace. The plastic disc and spring keep the seal pressed up against the back of the piston and so keeps it 'square' to the bore to give a seal. The spring also has the effect of pushing the piston out, which pushes on the push-rod, clevis pin, release arm, release bearing and clutch cover-plate to take out any mechanical wear in any of these components. Contrary to popular opinion physical wear in these components does **not** contribute to a low biting point or grinding in reverse like similar wear at the master cylinder end does (see 'Clevis Pin Wear' above). Also any crankshaft end-float movement towards the back of the engine will act on the release bearing, arm and so on to push the piston back into the bore, which without this spring will mean that the first bit of pedal movement might be required to take up the free play created if the crankshaft has subsequently moved back towards the front of the engine, which again will give a low biting point but more importantly an inconsistent one which will lead to stalling and over-revving.

With all components out examine the bore. I'm pretty sure both piston and cylinder are all-alloy. This cylinder had corroded quite badly causing cavities towards the open end, but also had visible corrosion further down. Only the bottom inch or so felt smooth and looked clean. If you are desperate to keep the original component then you could have it bored out and sleeved, possibly. In this case honing wouldn't have got rid of the cavities, and any more aggressive treatment would increase the clearance between piston and bore, affecting the alignment of the piston and hence the hydraulic seal without sleeving. Unless the car is off the road long-term for comprehensive restoration a new slave is really the only sensible way to go, and guaranteed, one way or the other.

Reassembly is the reverse of removal. Make sure all components are scrupulously clean, the three holes in the plastic disc clear, and the spring fitted to the plastic disc. Drop the spring and plastic disc in the cylinder disc upwards, then the hydraulic seal on top of that flat face upwards. Then insert the piston with its conical depression facing upwards, and fit the external boot over the lip of the cylinder. If you have removed both hose and bleed nipple, make sure the hose is refitted to the port that faces towards the front of the car when installed, and the bleed nipple faces across the car and is uppermost. Note that new slave cylinders come with the bleed nipple in the 'wrong' port. Originally I wondered whether that is where it is needed for its original application if it is used on vehicles other than the MGB, or whether it is just to save a groat or two on packaging. However looking in the cylinder you will see the hose port is in the back wall, whereas the bleed port occupies an arc at the angle where the back wall joins the side walls. This latter port will definitely be more effective in getting all air bubbles out of the cylinder than the other one, so I guess it is just down to packaging.

**Replacement** *November 2012*

I'd noticed recently that Vee's clutch master has needed topping-up several times during the year, normally it doesn't need it from one year's end to the next. No leaks down the pedal, or apparently dripping on the floor directly under the slave, although I have noticed more drips generally on that side of the engine. Jacked up the front and peeled back the slave boot, and it was full of fluid, so that's definitely the culprit. I'd already changed this once so wasn't best pleased, although it seems par for the course these days. Checked back and it was done (with the master and the hose) in 1999, which is 13 years and 30k ago, so not that long ago really.

Started checking suppliers and prices and found the latter ranging from about £25 to over £80! Brown and Gammons are showing two - GSY113 at £57 and GSY113Z at £25 so that explains some of the disparity in prices - the Z suffix indicates a copy part, the one without should be OE. Can't remember having a choice before, but opt for the OE, and get a sump gasket as well ready for when I do the big-end shells.

My new full-length ramps make working under the car a doddle, plenty of room, and much easier getting under and out. Clamp the hose near the slave, loosen the hose in the slave, then undo the mounting bolts. Once off the bell-housing slide it off the push-rod, and unscrew it from the hose. I see there is a green cap on the slave nipple - don't remember putting that there.

Get the new slave out of the box and notice there is a green plug in the hose hole, which when prised out is the perfect size to act as a cap for the bleed nipple - so that's where it came from, how neat is that? Next question is how the slave is going to be orientated when screwed onto the hose. If the thread start is in a different place then it will be orientated differently, the hose would be twisted if I mounted it like that, and the fixing and flare nuts would have to be slackened to allow the hose to be straightened. As I changed hose and slave together last time it wasn't a problem, and the V8 bracket is much easier to get at than the 4-cylinder anyway. When I changed a pals 4-cylinder slave a few years ago the new one didn't line up, we couldn't get the fixing nut undone, but fortunately an extra copper washer on the slave end of the hose did the trick. With this one it lines up perfectly, so either I was lucky, or the old slave





was an OE as well and they all have the same thread start point. Loosely fit the slave to the bell-housing to I can fully tighten the hose.

The next thing is what to do about bleeding. Many people have said in the past they have found it impossible to get all the air out, even with continuous pressure bleeding from the top, even more so with the pedal. So much so I didn't even bother last time, reasoning that it's going to be much easier to push air up that long metal pipe, I connected the Gunsons EeziBleeder to the slave nipple, and used very low pressure, and it fully bled straight away. Subsequently someone mentioned using the right-hand brake caliper as the source, and as they have the same bleed nipple sizes that's even easier, as long as you open and close the caliper nipple as an assistant presses and releases the brake pedal, which has to be done very slowly and gradually or it will blow the pipe off the nipples. That's OK for a complete fill and bleed, and is what I used on my pal's 4-cylinder. But I only need to bleed the slave, and I don't want to push all the air that is in the pipe through the system as well. Also I don't have an assistant to hand, and at the moment when the car is on the ramps I can't safely get the wheel off, so I ponder yet another method. I took the slave off the bell-housing again, removed the hose clamp, and with a pointed screwdriver through the hole in the boot push the piston all the way back into the cylinder, then release it, so the internal spring can push the piston out again, sucking fluid down from the reservoir. I'd checked the fluid level in the master first, and put cloths round it, to prevent an overflow. Some gurgling is heard, so some air at least has been pushed out. Do that again, but no more gurgling, so I refit the slave to the bell-housing. Check the master and the level has dropped a little. Try the pedal and it is very light for the first half of travel, and with a mirror check the movement of the push-rod, which is only about 1/4", so still some air in there.

Try pushing the piston back again but no improvement. It's pretty cold, so the fluid will be a bit thick, and air bubbles will take time to work their way up to the top of the pipe. It's only once they get here that pushing the piston back will stand a chance of pushing them out via the master and the reservoir. So I decide to leave the slave dangling for a while with my 500w halogen work lamp pointing in its general direction to warm things up a bit, while I remove the push-rod from the release arm. This is in order to clean it up, as it has a rough surface from rust, gunge or both and I don't want to tear my new slave boot. By the time I've done that, and tried to get the piston out of the old slave (which moves so far and then stops so I leave that for another day), and refitted the push-rod I push the piston back again, but again no gurgling. Refit it, the fluid level has dropped a bit more, the 'feel' is much more like I remember, and the push-rod is moving noticeably more now. So worth giving it a try. Start the engine and tentatively select reverse, and it goes in sweet as a nut i.e. no grinding, and take it for a quick drive round the block. Biting point still feels a little low though, but that's enough for one cold day.

Next day I take it for a longer run, and the pedal feels even more normal after standing overnight. Get it fully up to temperature, and the cooling fan cutting in, so the fluid should be thinner and the vibration will have joggled any bubbles free of the walls, to rise to the top of the loop by the master. Switch off, hold the pedal fully down with a piece of wood between it and the seat frame, and tap the metal pipe with the handle of a plastic screwdriver from as close to the bottom as I can get, all the way up, to hopefully knock free any bubble stuck to the walls. The principle of this is that when I eventually release the pedal, all the bubbles should have gathered at the top, and releasing the pedal will move a slaves-worth of fluid up the pipe and into the master and the reservoir, taking all the bubbles with it. After about half an hour I remove the piece of wood. No more gurgling, but the fluid level has probably dropped a little more, and the pedal now feels completely normal.

So no messing about with bleeding at all, except for pushing the piston back into the cylinder a couple of times. Whilst this can be done with the release arm and push-rod, I'm pretty sure that doesn't move the piston all the way back in, so removing it and using a pointed screwdriver through the boot will have a greater effect. However for a job like this, i.e. not a drain and complete refill, it's possible that simply running the engine at a fast idle with the clutch pedal depressed for a while, bonnet down, to get some heat and vibration into the system, then release the pedal, would be all that is needed.

As for the innards of the V8 slave, they are quite different from the 4-cylinder. A really chunky piston, where the ring-type pressure seal has to be stretched over the piston and into the groove, like a brake slave. Hence the significantly longer body of the V8 type, compared to the 4-cylinder.

**Another pal's slave change,** *June 2013.*

This was opportunistic while the engine was out to replace a faulty overdrive unit. It does mean that one has to take a punt at the angle of the slave when mounted to the bell-housing in order to tighten the hose fittings on the chassis bracket and not have a twist in the hose when it is attached to the bell-housing, but it is about 45 degrees to the vertical. One thing we could have done but didn't was to loosely attach the slave to the bell housing so we could tighten the hose into the slave, as that is much easier than tightening the slave onto the hose, as it were. The usual odd sizes of nuts on the pipe and hose, and hex on the hose, even different between old and new hoses! Pre-bleeding done by using a spare push-rod in the slave to push the piston all the way into the bore, with much gurgling from the master, then releasing it and watching the internal spring sloooowly push it out again. Half a dozen repeats over a few minutes to allow air bubbles to float to the loop at the top of the pipe, then no more gurgling, it will be interesting to see how the travel is when fully fitted. In the event it needed further bleeding.