A beginners guide to Burman II – by Joe Rayner

Part 2

Burman Gearbox Wear and Tear

Here we look at physical wear and damage in the gearbox and consider what can be done.

Within the excellent POC Library there is a Burman Gearbox manual and instruction booklet that considers various symptoms and where the problem might be located within the box – ie, kickstart not returning - a broken kickstart spring etc. So if your gearbox already has a particular problem look at the Burman information first, and then strip the gearbox as a last resort!

Not everyone has deep pockets and not every part of the gearbox is available new, so some compromises will be made. If a bit of gearbox whine doesn't matter to you, then so be it, but if the bike jumps out of gear then maybe you'll be looking to find the cause and fix it.

This gearbox was something of a mystery – the box had clearly been worked on, was very clean inside, with what appeared to be good bearing races, and new mainshaft oil seal kit. But....it groaned a bit and whined in lower gears, but was quiet in top gear. First impressions when taking it apart was that thankfully the easy (but expensive) parts had been changed but the Oilite bushes, not expensive, and slightly more challenging as they need reaming to size, had been left untouched. Also some things were not quite where they should be....!

So the symptoms matched up pretty well with the finding of worn layshaft bushes, and the hopefully the 'cure' will prove to be 'relatively' inexpensive.

On the subject of expense, in the 50's and 60's when a working wage didn't leave much over to mend a Panther properly, when tools were expensive and a shed a bit of a luxury, most owners wouldn't have considered doing what we do with our bikes today. The parts costs now are relatively low, tools cheap, and the bike isn't needed for work next day. So the approach here is by no means 'no expense spared' – it will be your choice to spend or make do and mend– but to produce a reliable unit that should last for thousands of miles before requiring further attention.

Measuring up.

Much of the assessment of wear and damage will come down to looking at parts and taking a view, set against availability and cost of replacements. However, measuring can be useful and a set of cheap digital callipers could be money well spent. The ones that you see in places such as Machine Mart for £20 are the same as those available on Ebay from Hong

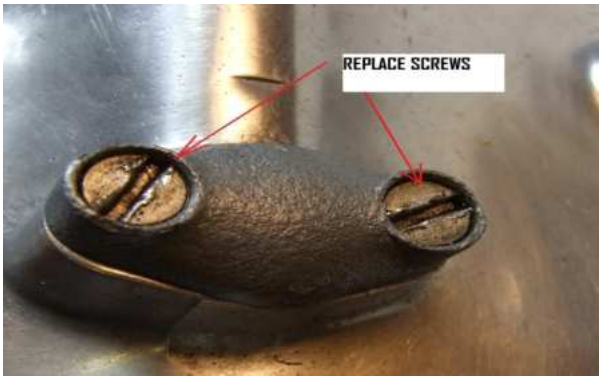
Kong – £6/£7 including postage! They may not be deadly accurate, but for comparative readings they are better than eyes and feel, and the big numbers help old fools like me.

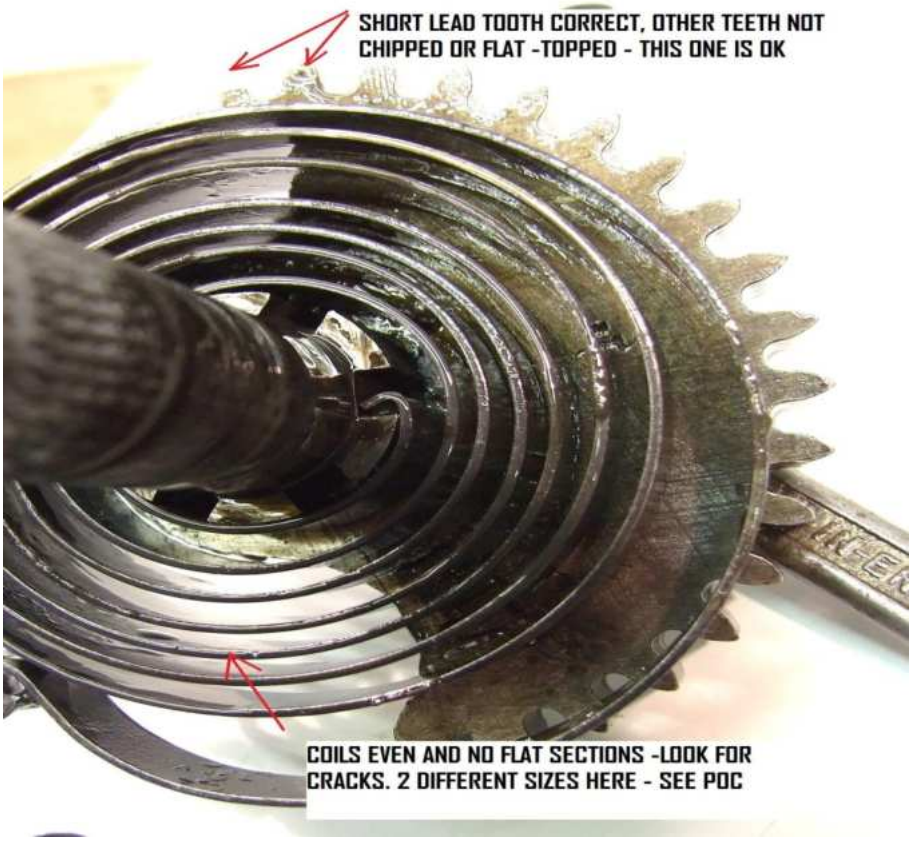
The casings & contents

Outer.

Check the outer casing for damage, cracks, oil leaks, shaft bush wear, thread damage. The part is now over 50 years old and will not be perfect. Cosmetics may polish out, cracks can be professionally repaired, thread inserts fitted, and better second-hand covers may come up. POC have a limited number of related spares, but Draganfly, in Bungay, Suffolk also carry some parts for Burman, and I believe that the Vincent Owners Club carries spares as the Vincent Comet was fitted with a similar Burman gearbox.

Kickstart springs are available from POC (wide & narrow), along with new studs, nuts and filler cap. The clutch adjuster cover screws are often victims of the dodgy screwdriver – Whitworth threads here, but widely available. Both the kickstart and gear selector shaft bushes are hardened, which means that the shafts can also become worn. This may lead to poor gear selection and oil leaks. If the wear isn't having an effect on the operation of either lever then it might be considered 'cosmetic', or a case of searching for something better!



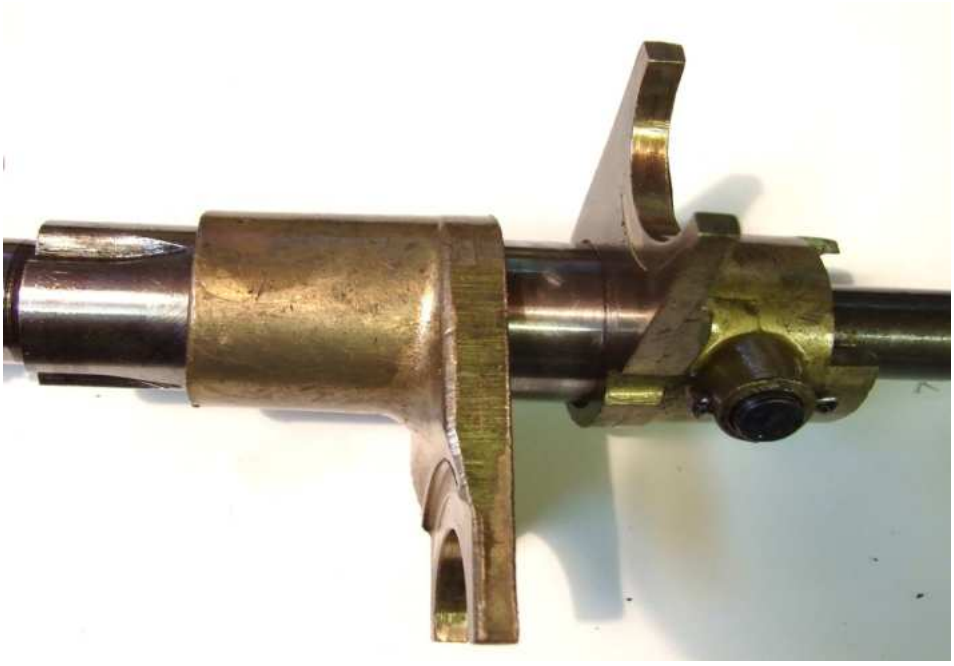


The Selector Assembly

The alloy spring box needs close inspection for cracks & damage, and the steel pin needs to be secure. The springs can wear ‘flats’ on their outer edges which may bring about failure – with the gear lever failing to return to the normal position. Spares are available.

The selector pawl assembly is riveted and the 3 rivets needs to be secure – if you need to tighten yours make sure that the shaft is in place to keep everything centred on the single rivet, otherwise you risk making it very secure , but in the wrong position.

The selectors within the gearbox can become bent or worn and there's not much that can be done by way of repair, so better replacements will need to be found. This looks like a replacement as it's in good condition. There is no great need to dismantle this assembly if the selectors are serviceable.

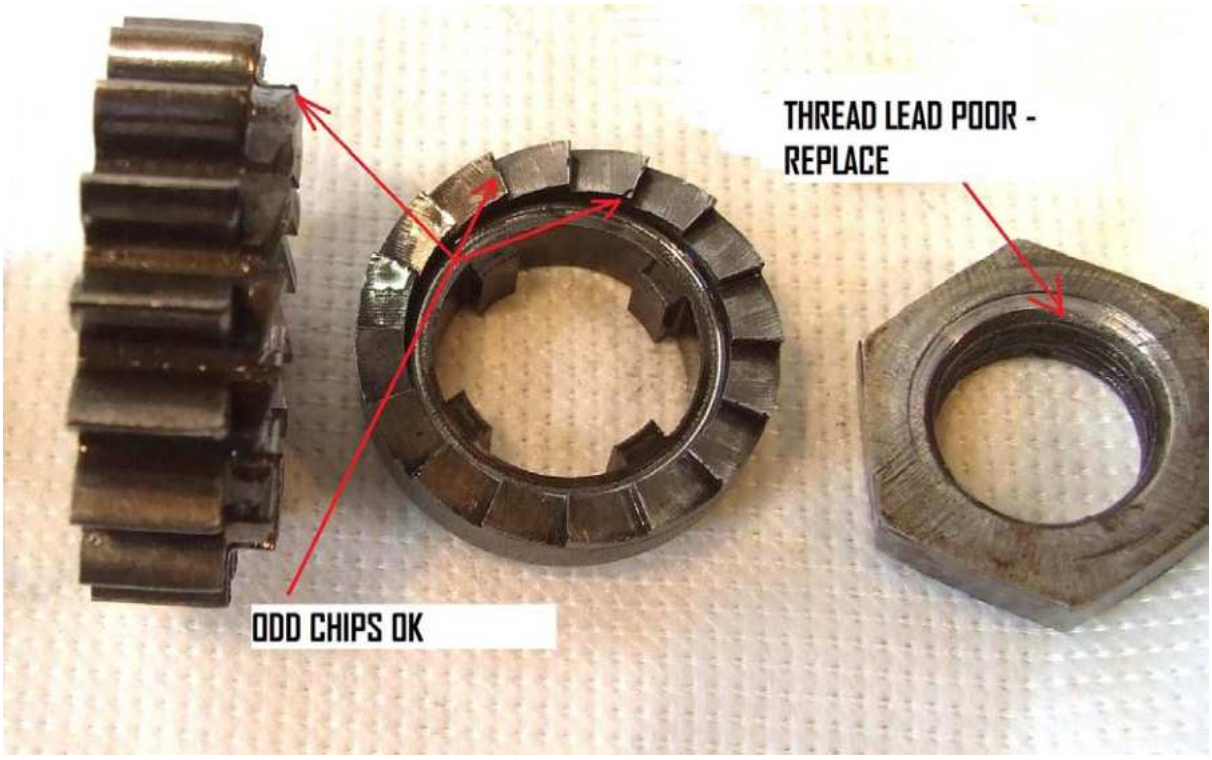


These had minimal wear, so good for re-use.

Middle casing

More chance of damage to bearing housings to be found here, mainly due to clumsy ‘reconditioners’ . Look for cracks around the outer main bearing area (front and back) . Also check where the kickstart stop pin locates. The pin may be wobbly, or the case cracked, due to repeated knocks from the kickstart quadrant – a rubber cushion is available from POC, but probably missing, or a crumpled ‘thing’ in the bottom of the case. See ‘Repairs’ section for remedies.

If the kickstart ratchet is prone to sticking – a ‘solid’ pedal as you push down – it may be caused by the ratchet teeth flattening off at their tips. If not too bad they can be carefully sharpened, but new available from POC. The same symptom can be caused by a sticking clutch, so free/adjust the clutch before thinking about taking the gearbox apart.

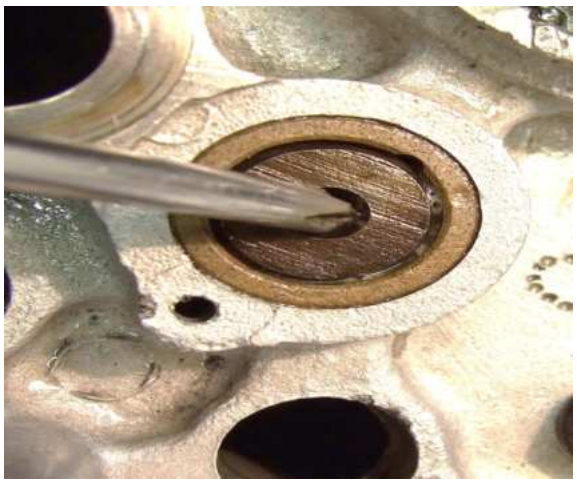


If in poor condition the above assembly is available new from POC, and the spring dimensions when new are 19mm L x 27.5mm O/D.

Shown, left, a very worn kickstart, compared with a used, serviceable one.

Look at the end of the layshaft when in situ and push it sideways with a screwdriver – you'll hear the oil 'click' as it gets pushed out of a worn bearing. New bushes are readily available

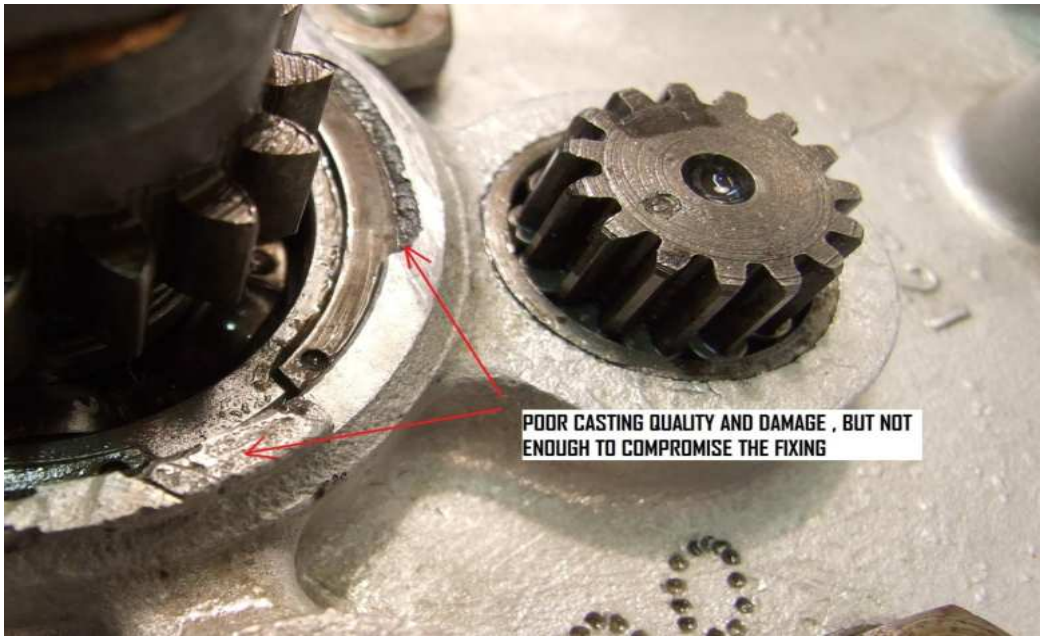
from POC and bearing suppliers, but need shortening by 2mm, an easy enough job. Once out of the heated cases the old bearing dimensions will change, and new bushes must go back into heated cases. It is false economy not to change the bushes, even if you need professional help with the reaming – reamers are now very cheap and it's a straightforward job to do it yourself. Note 'trough' machined in bore at 2 0'clock position. New bearings don't have these - you'll be cutting this too, after reaming.



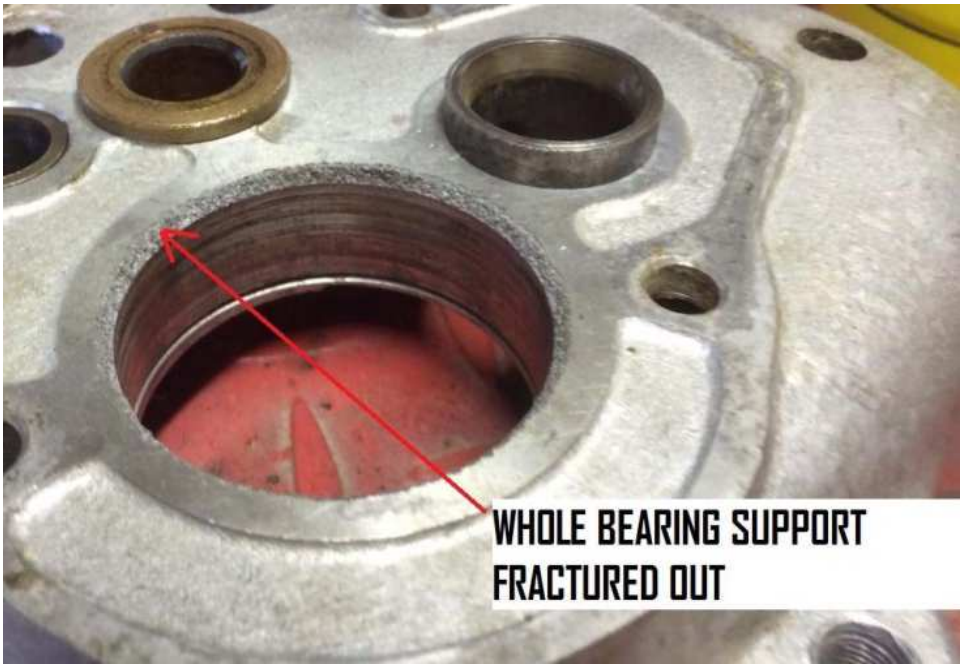
If you intend to ream your own bushes and haven't used a reamer before, then practice on your old bushes whilst they're still in the cases. More detail on doing this later.

Mainshaft outer bearing housing, in the 'middle' layer of the gearbox needs inspection – check for bearing 'spinning' in housing & general damage , on both the bore and the thin walled casting beneath the bearing. This bearing had been incorrectly assembled, with the steel spacer placed below the bearing, not above, directly under the circip, as it should be.

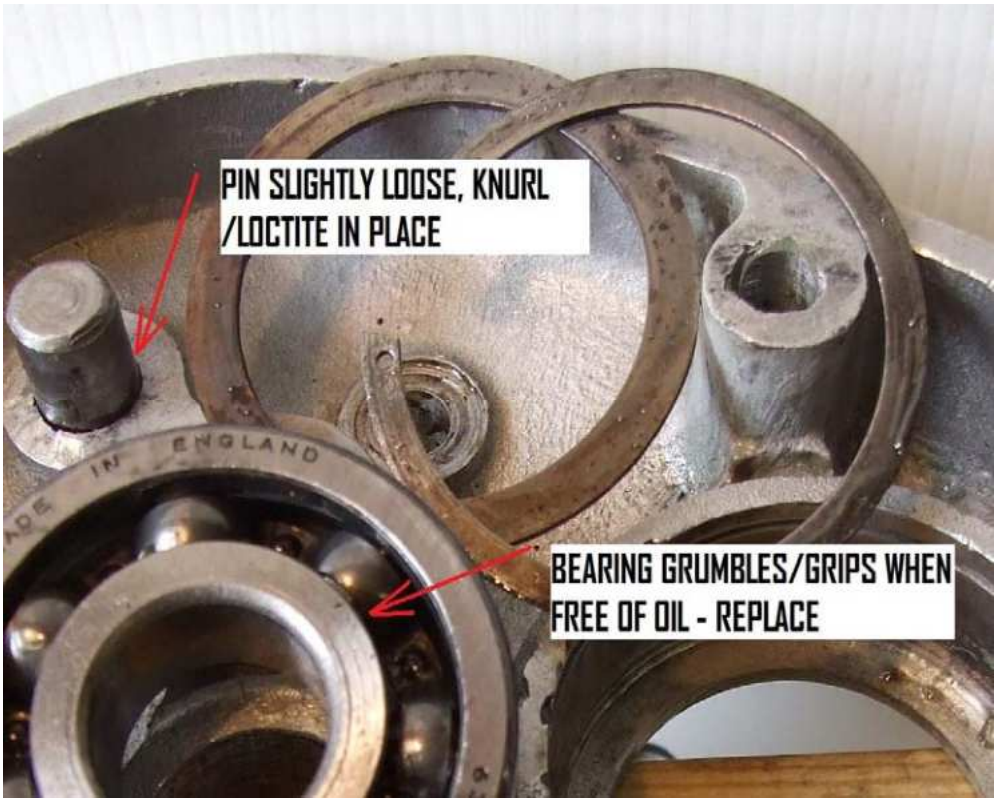
This allowed extra backlash in the mainshaft, affecting the clutch and gearchange.



The next one needed a lot of thought! This was the back of the middle casing, outer mainshaft bearing housing . It's not there! Possible causes may have been the bearing being pressed into place without supporting the back of the casting, or levering the clutch hub off of its splines. It needed professional expertise.



Thanks to Rod Duncan for the above 2 photos.



As with any accessible bearings, if in doubt, replace. This outer main bearing, relatively new, initially felt OK, but a wash out with a squirt of carb cleaner revealed that it didn't spin smoothly, and a judder could be felt as it slowed, so maybe some pitting. Available from POC and is a standard metric bearing, SKF 6304, held by all bearing suppliers and widely used on agricultural equipment, as are new circlips.

The kickstart stop pin takes a battering and should have a rubber buffer fitted. Without it the kickstart, if released suddenly (or a Panther kickback) hammers the pin and casing. The hole becomes eccentric and the pin can bend too. The pin can be knurled if you have access to a lathe, or a slightly larger pin made, and Loctite can help to secure a slightly loose pin. Fractures may radiate out from the pin hole, but probably not far, so welding may not be necessary. Fit a buffer from the POC or make up one from a short piece of reinforced high pressure fuel hose, or nylon if you have access to a lathe.

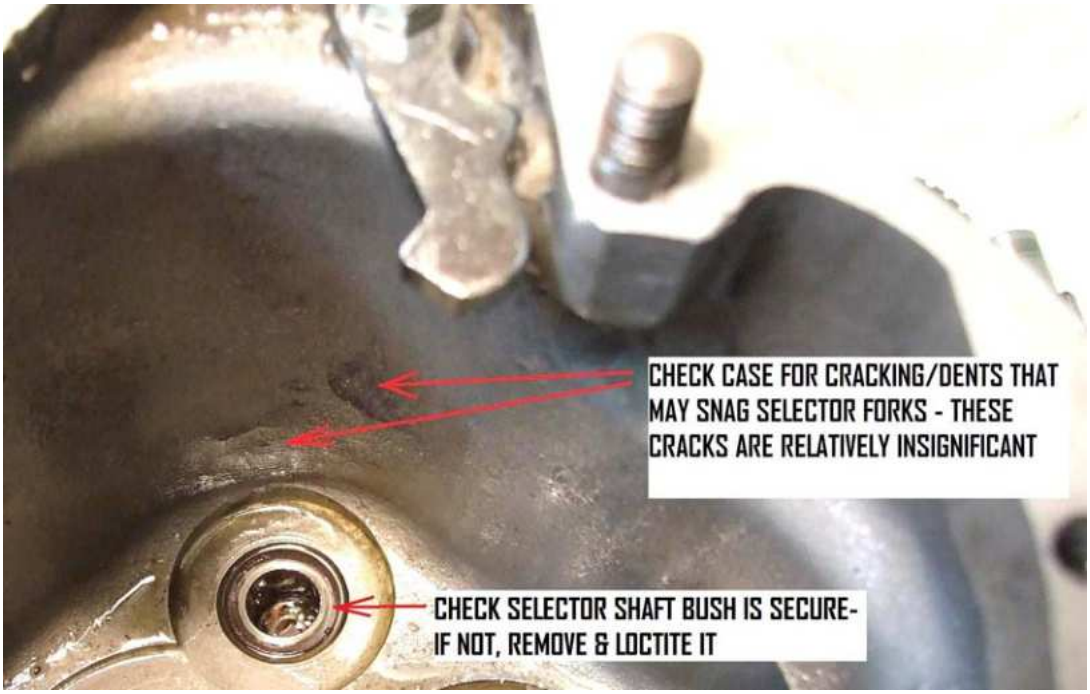
A knurled pin, ready to fit – note how the pin diameter has 'grown' .

Selector shaft rollers are available from POC, and unless funds are tight, should be changed.

The clutch ‘clevis’ pin can wear unevenly and is available from POC – you may be able to re-face the end of this one by grinding. In situ it should have a ball or roller bearing between it and the clutch rod.

Main casing

Stud thread damage is possible, along with dents & cracks. The gearbox can collide with the frame member and it pushes a dent into the casing, which, if deep enough, stops or interferes with the gear selector assembly.



Check detent spring for length & distortion – these are available from POC.

The clutch end large mainshaft bearing may be loose in the casing and have 'spun'. Look for scoring/check for loose bearing in housing. Loctite bearing locker will fix this. This one is good, but the bearing came out very easily, so Loctite Bearing Locker will be used on reassembly.

Circlips available from bearing suppliers – take the casing and old clip along if you have a local supplier.

The Gears.

The gears probably all looked as good as new when you opened the oily gearbox, but close inspection probably revealed a few flaws, most of which have relatively little impact on the working of the gearbox, but may add to noise. Some erosion/corrosion on this main gear, but it's going back in, once new bushes have been fitted within, but it may add to the whine!

The gear teeth may have eroded areas, chips, cracks etc and every one needs close inspection. The most likely symptom will be noise, but a broken off tooth might have done a lot of damage.

Check inside bottom of casing for chips/swarf. If a gearbox has been sitting on the floor of a shed for years the insides may well have rusted – dirty oil, grease and condensation make a surprisingly good corrosive mixture, and old oil offers no protection. An Ebay gearbox may have been put under the bench and saved because it was good, or slung there and forgotten because it was worn out! Also, it doesn't take much effort to clean up the outside of a clapped out box and put it on Ebay – ten minutes with a pot of Gunk and it will look great.

Finding good second-hand gears may not be easy, as the ratios used in similar Burman boxes are not necessarily a straight swap, as the gears are paired sets– put a bigger one on one shaft and it needs a smaller one on the other.

Check the smaller engagement dogs within the gears – it's these that you crunch when swapping cogs, but they are remarkably tough. Bad wear or missing teeth, not good – if you found metal in the bottom of the case, it's a sign that something has taken a battering!

The Mainshaft

This needs close inspection for thread damage, spline & shaft wear, particularly in relation to the drive gear sleeve, which contains a pair of thin-walled Oilite bushes. The bushes are likely to be worn, but they may have also, to a lesser extent, worn wide grooves in the main shaft.

Unfortunately any replacement bushes can only be reamed to the original shaft diameter, so if there's wear on the shaft, there will always be some play in the finished assembly. It's a matter of judgement – if the shaft has 3 thou of wear, and the old bushes another 12 thou, then with new bushes reamed to original diameter, then you'll end up with 3 thou clearance, so a worthwhile gain from where you started at 15 thou! It is possible to get the mainshaft chrome plated and ground back to standard, or new ones are available from the POC. This shaft clearly has a pair of worn bands that match with the Oilite bushes of the main gear, but not so awful that it can't be put back into use, especially as the clutch splines are good.

A check to see the impact of wear in these bushes on clutch 'wobble' is worth doing, just to convince you that changing the bushes is worthwhile. Set the mainshaft & drive gear onto the shaft and re-fit the large drive nut, as shown, with a couple of small Mole Grips , or a straight edge across the nut face.

Rock the drive gear on its bearing and the movement will be similar to the rock that is found at the clutch sprocket teeth. I set up a dial gauge, and, on a 'moderately' worn bearing/shaft, there was 20 thou+ movement at the same diameter as the clutch –

which is a 40 thou rock when you wriggle the clutch in situ. Doesn't sound a lot, but feels it!

The 2 Oilite bushes inside the main gear cost very little, but fitting and reaming requires some workshop equipment/tools. To a professional engineer they are a piece of cake, but to mere mortals, more of a challenge .....you'll see the results in the 'Rebuild' section!

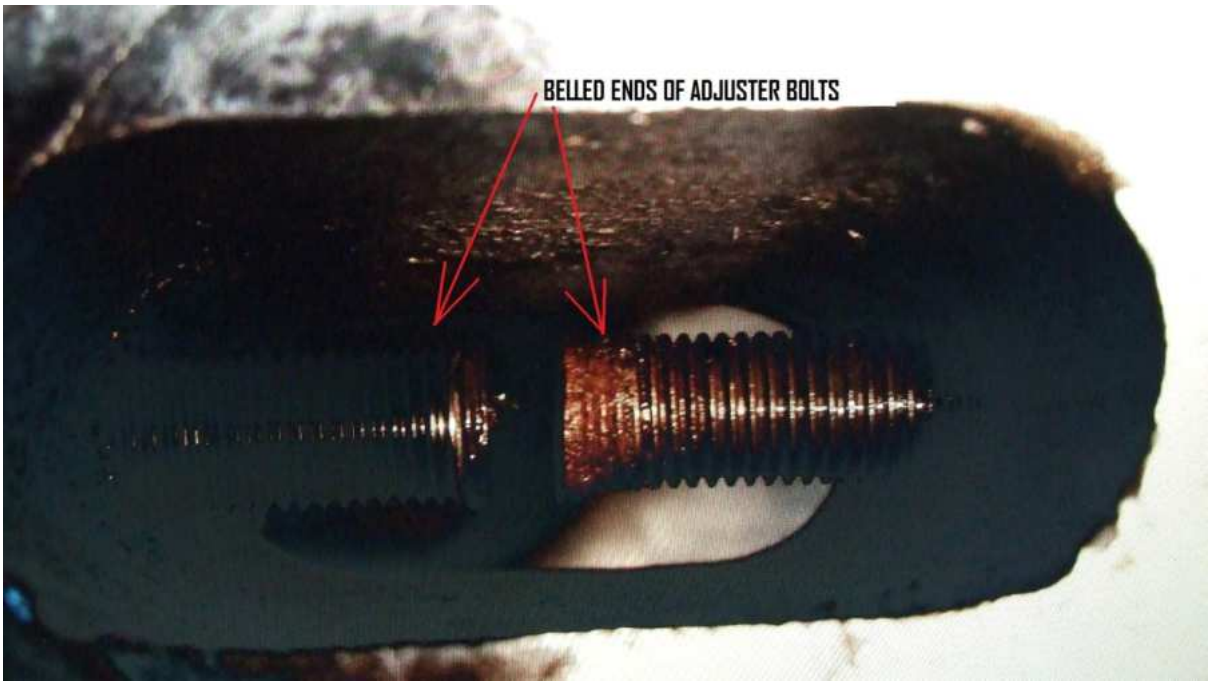
Measure the worn part of the shaft and the bearing bore – the difference is the clearance, in my case 15 thou". In addition, if there is wear in the mainshaft ball race it will compound the above problem. Fortunately the race in this box was good, and as the races are an odd mixture of Imperial and Metric, they can only be sourced through the POC.

The clutch end of the mainshaft is splined to accept the clutch hub and all of the engine power passes through those slots. It's no surprise that they become distorted/worn, and damage here may tip the balance towards a new shaft. A damaged one can be welded and re-cut, but at £60 a POC one could be a cheaper option, especially if you have both shaft wear & thread damage.

Later POC clutch centres have deeper splines which engage with almost the whole of the mainshaft grooves, and damage therefore avoided. These slots are pretty good.

Adjuster bolts

At the bottom of the gearbox there are 2 adjuster bolts that thread through the gearbox mount and these may have stripped the casing thread, or be impossible to remove. There are a number of ways to deal with this problem and they are described at the end of this section . Don't attempt removal if like this – you will destroy possibly good casing threads!



Thanks to Bevan Clarke for this photo.

The BSF threads on the adjuster bolts shown here are in good condition, but any attempt to remove them from the casting will strip the alloy of its threads, and the bolt will still be stuck. Choices are to attempt to file the ends off of the bolts or to wind them out with your fingers until they bind. With a lock nut left on the thread, saw the bolt off a couple of mm short of the lock nut. Cut a hacksaw slot in the short stump of the bolt and wind off the lock nut. This will tidy the cut end of the bolt, preventing damage to the alloy casting.

Use a screwdriver to wind the bolt back in through the casting and it will fall off inside, allowing you to replace it with new.

If the thread has stripped then either drill the hole out and tap to a larger size, or have a thread insert fitted and keep the original BSF size. Both will do the same job.

Shown is a replacement Helicoiled bolt – it's worth chamfering the bolt end a little, to allow for future mushrooming of the end.

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An alternative, if the casting is in a poor state, is to make a steel shoe – (I've made one of these for a POC member but can't find the photo!). Basically a 2" wide flat plate, 6mm thick, with two 1 ½" uprights welded on that are a close fit to the casting bolt holes. Drill and tap the upright plates for 8mm or similar bolts that will pass through the remains of the original holes. The bottom of the shoe will be in contact with the flat bottom of the gearbox casting, and the uprights must be flush with the 'ends' of the casting in order for it to work effectively.

A repair like this can be used 'in situ' if you gearbox adjusters have stripped and you'd rather not remove the gearbox for repair. It works perfectly well and cannot be seen.