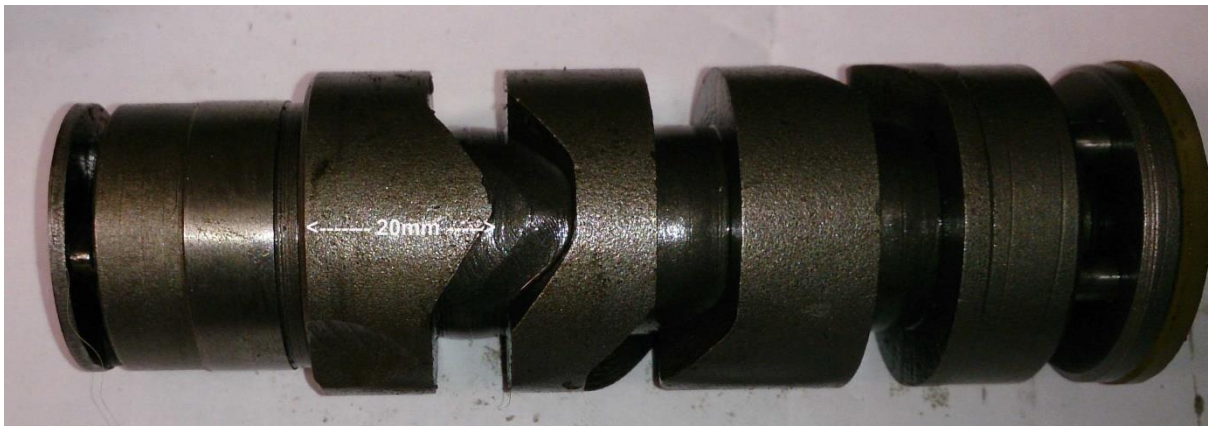
MZ Supa5 Gearbox Woes – A new Theory on the causes

Background:

ETZ250 and to a lesser or more recent extent Supa5 gearboxes have long been subject to problems of jumping out of third gear usually after a high mileage though the no one yet has defined 'high' in this context. The usual cure is to replace 3rd gear, the 1st/3rd sliding gear and the 010 selector. The cause has traditionally been attributed to poor machining of the selector drum which results in the projection which engages 3rd gear not being long enough. Hints & tips Part 2 suggests this figure should be 20mm but most seem to be <19.5mm.



Some while ago I was asked to repair Supa5 motor which had the 3rd gear problem. Possibly a significant factor was that the whole bike was sold very cheap because the engine had long given problems in another bike. Anyway 3rd gear problems apart the rest of the engine and gearbox appeared to be fine so it was rebuilt with replacement 3rd gear 1/3 slider and 010 selector. I lost touch with the owner afterwards but some time later I was approached by a new owner of this same bike. He said that after only 20 miles or so the gearbox was violently jumping out of 3rd gear though otherwise it went fine. He brought me the engine and results are documented below.

Engine Strip:

The engine stripped quite easily with no obvious problems, no swarf or broken bits in the bottom of the gear chamber anyway. The 010 selector was showing signs of wear but it was polished rather than measureable. It was far from the point where it was blackened from excess heat and half its original thickness which is how they normally appear once the gear jumping problems become starts. The selector drum projection measured 19.3mm which I would have said was well within the range of acceptability, the only other one I had available was 19.4mm and H&T Vol 2 mentions figures as low as 18.75mm.

What you can see in the drum picture above is that one edge of the projection is worn away, it should be flat. My guess is that this was caused by the violent jumping out of gear pushing the 010 selector into the drum and probably turning it sufficiently to turn the drum and deselect. The 1/3 slider gear had lost its undercuts on the 3rd gear side and is probably scrap after only 20 miles or so of use. I could not easily see or measure the state of the undercuts on 3rd gear but I imagine they will be in a similar state. The other odd thing was that the retaining circlip for 3rd gear was not in its groove so third gear could move away from second gear. However, since it would be pushed back into place when 3rd gear was selected I could not see that this by itself was the cause of jumping out of gear; though it could clearly generate other problems.

Other than that I could see nothing obvious wrong and my first thought was that the pattern parts I had used were rubbish. However, I decided to investigate further and made an interesting discovery, the spacer (distance piece in MZ terminology) between 2nd and 3rd gear was considerably wider at 8.6mm than the one in another gear cluster I checked which was 7mm. I think that this is a home made item and goes back into the history of the gearbox problems with this engine.

Comparing the two gear clusters, my control set had quite a lot of slack around 3rd gear whereas the suspect cluster would barely allow the retaining circlip into its groove and indeed under use it was clearly coming out (see comment above).

I have a sectioned set of Supa5 crankcases and when I assembled the suspect gear cluster in them it was very difficult to select 3rd gear, the wide spacer pushed 3rd gear so far forward that the slider gear was binding before it was fully engaged. Moreover 2nd and 3rd gear were tightly pressed together and not free to spin independently. You could see the pressure marks of this excessive contact on all the relevant parts.

Initially I thought that this excessively wide spacer was the whole cause of the problem but the more I thought about it the more I became convinced that something else was involved. In theory increasing the size of the spacer pushes 3rd gear into engagement with the 1/3 slider gear so this should help meshing rather than causing jumping out of gear. Examination of all the parts established that full mating of the gears was actually limited by the movement of the 1/3 slider gear. On the bench with no circlip or thrust washer the gears would mesh very close together. The 1/3 slider gear has a recess and this is wide enough for the circlip but not quite wide enough for the thrust washer. (The depth of the recess is greater than the combined thickness of the circlip & thrust washer – at least on the aftermarket gear I am testing). You can see in the next two pictures how the dogs protrude right through the gear when no washer is in place but do not protrude fully once it is used. In an assembled cluster the difference is

penetration is about 1mm; the sum of the thickness of the thrust washer plus the difference between the thickness of the circlip and the depth of recess.

My next move was to very gently grind the outer circumference of the thrust washer such that it would fit inside the 1/3 slider gear recess. I then reassembled the cluster and now have gears which will fully engage with a little slack to allow them to move comfortably into position. I had already slimmed down the distance spacer to 7mm, in hindsight I wish I had left it a little wider as with my thrust washer alteration, it could safely be at least 7.5mm.

This of course is all theory; I need to do two things. The first is to get hold of some original 1/3 sliding gears to measure the width and depth of the recess. The second is to test my modified gear cluster without changing any of the parts. My feeling is that though damaged, they will remain selected because they can now fully engage. The rebuild itself will be easy enough; the bigger issue is persuading the owner to let me do it and then test the engine. If I am wrong the rebuild will have been in vain but I think it is still worth trying.

Further Thoughts:

I stripped what I believe to be an original layshaft gear cluster and measured the depth and width of the recess on the 1/3 slider gear. The pattern part is 2.21 deep and the original part 1.81. The width of the recess is 26.43 on the pattern and 26.13 on the original. The original cluster thrust washer is 27.01mm wide so obviously it would not fit into the recess on either gear which was puzzling. Even more puzzling was that 3rd gear would fully engage on the original cluster despite the width of the thrust washer but the pattern 1/3 slider would not. Clearly there is sufficient difference in the machining of the pattern parts. Whether this would have been sufficient on its own cause the problem or it was a combination of this and the additional width of the distance piece I don't know. However, I shall be thoroughly checking this aspect whenever I rebuild an MZ 5 speed engine in future.