The web home of the UN1 gearbox!

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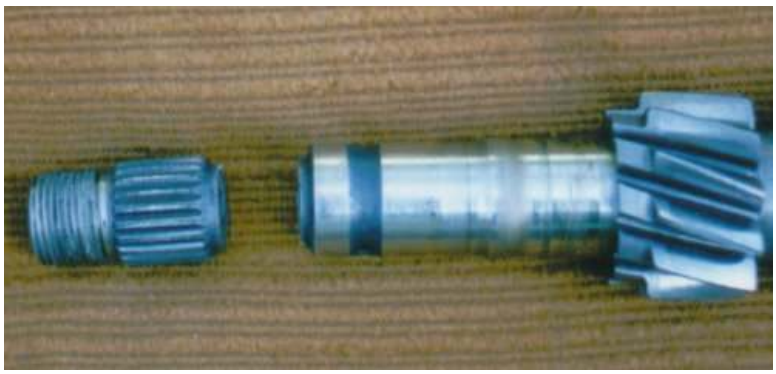
Upgrading

Introduction

The Renault UN1 transaxle is very popular with various kit cars and replicas because it is (was?) easy to find, light, convenient in design for a mid engine installation (e.g. Lotus Esprit) and able to take much higher powers than normally intended. If you use the car mostly on the road, with no sprinting, and not using full chat in 5th and drive with empathy for the machinery, you will probably have no problems.

However, all things have limits and as owners of mid engine V8 powered replicas push power outputs above a mild level of tune with a 302 or 351 V8, the UN1/369 is right on the limit. The problem comes when you want to strengthen the transmission as it is basically at the heart of the car, change the gearbox and you may well have to change the bell housing /adapter, clutch, gearchange linkage, drive shafts, CV joints, gearbox mounts etc etc. The alternative gearboxes are not cheap, and then you have to spend a lot of money and /or effort getting it to work!

This is what a 500 HP small block Chevy did to the 5th gear end of the first motion shaft, snapped like a carrot!



This was the problem I had with my Lola T70 with the Small Block Chevy, In view of the above difficulties in changing the gearbox, I resolved to try to strengthen the Renault as being the easiest solution, if it was possible.

Background and weaknesses of the box.

I was however told by someone in the gearbox trade that it was originally designed as a racing/sports car gearbox by ZG. Certainly, as I got into gearbox design myself, I was struck by the similarity of the internal design to some Porsche (ZG) boxes for example.

It actually has a reputation as being a tough gearbox, any box that can take what the average van driver dishes out must have something going for it!

But the nemesis of a gearbox is torque, not horsepower. With the weight of an iron block V8 pressing sticky slicks firmly to the ground, and 420 lbs.ft. on the input shaft, there is nowhere to hide, and the weakest link will fail.

In the UN1 (the 369 is only very slightly different in small details), there are two main weaknesses and one lesser one.

1) the overhung 5th gear (like many 5 speed boxes, the 5 speed UN1 is the earlier 4 speed version with an extra gear hung on the end!)

2) the small diameter splined link between the clutch/input shaft, and the first motion shaft

3) Flexing of the first motion shaft between the two ball bearings due to the thrust pushing them apart.

The good news is, all of these weaknesses are in the first motion shaft. The output shaft on the gearbox is massive and I've not heard of it failing, usually it is protected by the first motion shaft failing first! So the obvious path was to try to beef up the first motion/input shaft assembly.

Up-rating Gearbox shafts.

What makes life difficult as far as putting high torques through a gearbox, is that if you are stuck with modest shaft diameters (which we are, because the input shaft has to pass very close to the differential, in a tube) then only high strength steels will enable the required strength to be achieved in the space available.

A widely used steel for shafts is EN24, this is commonly used for good quality drive shafts. This is a “tough” steel in that it cannot be hardened to the levels that EN36 can, but can take some elastic deformation, whereas EN 36 is more stiff , it will break rather than bend, although it takes a lot of force to do either.

The point is, that to obtain the required strength in a gearbox shaft, you need

1) the right alloy

2) the right heat treatment

3) the right surface treatment.

One possible solution which has been tried (and failed) is to eliminate the weak joint between the two pieces of the input shaft by welding.

The process of welding, however you do it involves generating high enough temperatures to melt the steel locally, this undoes the local heat treatment of the steel, both through the bulk and the surface. In the weld itself , the crystalline/grain structure of the steel which is a critical factor in the strength of the steel is completely changed, almost certainly for the worst. If the welding technique (e.g. MIG, or TIG) deposits new metal, then the composition of the weld metal will also define the strength of the final shaft, general purpose MIG wire is pretty soft and is unlikely to have the required strength.

I considered various ways of joining the existing Renault shaft to the clutch extension shaft to improve its strength and get rid of the necked down weak area, but could not think of a way that got round the above difficulties. In fact, I came to the conclusion that the whole assembly, even without the weakness, had little strength to spare, which is why I went for the one piece shaft.

The one piece shaft

I increased diameters wherever possible, eliminated the spline joining of the two pieces and all possible undercuts, and upgraded the steel, and the resulting shaft has given no trouble. I originally made it from EN24 so that the shaft had a little “give” so there was some resilience to absorb torque transients, but had to make another from EN36 because the shaft flexed too much between the two main bearings in the gearbox first motion shaft, which spoiled the mesh between the two shafts, and also the case hardening was less durable.

As you can see, the new shaft (upper shaft in photo above) eliminates the necking where the clutch and first motion shafts join, is larger in diameter wherever possible, and particularly so at the (overhung) 5th gear end which is substantially thicker , and has no undercut. the clutch spline is bigger as is first gear. You can see the 5th gear end in detail below. Note no stress raisers in the form of step changes in diameter or undercuts, and larger in diameter throughout.

As you can see below, it is the step changes where the trouble starts. these are two broken 5th gear ends from two different gearboxes which have failed in a very similar way,. starting at the undercut.

The EN 36 shaft has given no trouble, and has withstood full power and torque in all gears including 5th at the Nurburgring (185 mph and still going). Further kits have been used in GT 40 replicas actively used in sprinting and hill climbs, including some with tuned 351 Windsor's and the only thing they have broken is drive shafts!

More recently, the Lotus Esprit community has discovered the upgrade (I didn't realise the Esprit used a (unique) version of the UN1 and now it has been used in tuned Esprits as well.

An upgraded Esprit gearbox

Although the new bits (the complete mod includes a higher ratio first and second gear and a host of smaller items including the seals needed to rebuild a box)) are not cheap, neither is any sensible alternative. Opinions vary, but the older Porsche 911 boxes are not regarded as being particularly strong as far as high torques are concerned (911's have mostly small engines), and the stronger boxes like the G50 are expensive.

Hewlands cost £7k plus second-hand, and are noisy and baulky (they are straight cut dog boxes!) for a road car, ZF boxes are mostly ex Pantera with low final drive ratios and cost £5K and up.

So I took the view that up-rating the Renault box was the easiest route, and I still think it's the still the cheapest way to a practical quiet synchromesh gearbox which has taken in my case 420 lbs.ft. and 500hp for 5 years now. The only other change required is the clutch spline which is now the larger Ford standard spline (1" dia, 23 teeth) for which clutch driven plates are easier to obtain than the Renault 24 mm spline, and cheaper for Esprit owners

For further information, contact me directly so I can email the full technical details to you.

Please note , for Esprit owners, I did **NOT** supply any gearbox parts used on the 5th gear Esprit 200 mph project!

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