

KEEPING AN EYE ON YOUR REAR END

The following heap of words relates to the large chunk of machinery under the back of your car. What you call it is up to you; the Factory variously referred to it as the final drive, the rear axle, the transmission and the differential. Whatever, I hope you know what I am talking about.

Fortunately this heading fits all Rolls-Royce and Bentley cars since we have never had a front wheel drive model. But along with most cars these days it is probably the most neglected area of the vehicle. For those that have never thought of it the rear axle has two functions, it carries the wheels and rear brakes, transmits the drive from the engine via a special gearbox and inside that is mounted a differential that allows one wheel to turn faster than the other.

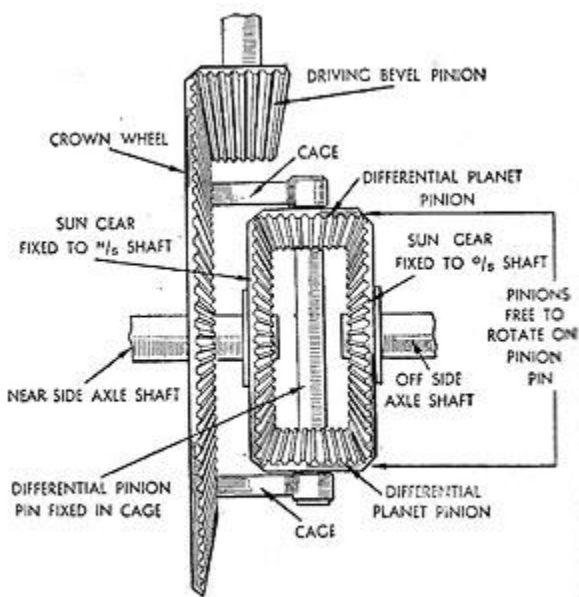
The latter I find is something that owners of any car never think of until I ask them whether they realise that the outer wheel on turning a corner must run faster than the inner one because it has farther to go. (Pause here for some readers to think about that). To do this a differential is fitted to allow the rear wheels to move independently. But first let's look at driving the rear wheels.



The pinion bearing assembly pulled from the diff casing of an S3 Continental. Note the build up of crud

Look left. The propeller shaft is driven from the gearbox and the crown wheel and pinion are in constant mesh. In the diagram the axles are rigidly attached to the wheel and the crown wheel. This arrangement incidentally was used on the famous chain drive Frazer Nash car. To get round corners you simply forced it and either the outside or inside wheel simply skidded!

SO TO SIMPLIFY CORNERING WE HAVE THE DIFFERENTIAL SEEN BELOW.



Differential schematic

Now if you are still with me you will see that the axles are no longer connected to the crown wheel, instead they are fitted with gears that mesh with a couple of planetary pinions. These in turn run on shafts housed in a cage and that cage is bolted to the crown wheel. So as the crown wheel turns it takes the cage with it, the pinion gears follow suite and turn the gears on the inner ends of the axles and the wheels go round.

So you are in boggy ground. One wheel is sitting in mud the other on firm rock. The slippery wheel turns because it has the least resistance. The crown wheel and cage keep revolving, the rocky axle stays still, the pinions can't stop because the cage is going around so they rotate and in doing so drive the slippery side like crazy! The trick here is to burrow through the mud and tighten the handbrake adjustment until the resistance is so great the rocky axle will start to turn. Mind you this involves someone else

driving and you being prepared to climb under a lurching screaming car in the mud. I think not but it hopefully illustrates how the differential works.

To a much lesser extent when the car goes around a corner the same thing happens. The inner wheel needs to go slower so it ‘transfers’ power to the outer wheel via the differential to the other side avoiding skidding and power is still being transmitted to the wheels.

And here we see a sectioned view of the real McCoy straight out of a Silver Cloud complete with more bolts than you will find in Bunnings! All the bits are there, the crown wheel (6) one of the planetary pinions (7) the axle pinions (18) axles (24) the diff cage (20) and the pinion right at the front of the assembly. Number 21 is one of two large roller bearings complete with their cage and you will notice the pinion also has two large taper roller bearings supporting it.

SO WHAT?

Well you might ask yourself when you last changed the oil in the back axle. Some lesser cars don’t even make provision for this operation just providing a filler plug to periodically top them up! It is at this point you will be advised of your peril.

There are two highly esteemed agents from Armageddon Land (read UK) who have been terrorising me over the question of tortured back axles. They are Norman Geeson generally recognised as a World expert in this field and Ashley James, raconteur, lethal critic and collector of immediate post-war cars, owner of the World’s only exclusive site for Mark VI and R Type Bentleys and oft times contributor to these pages.

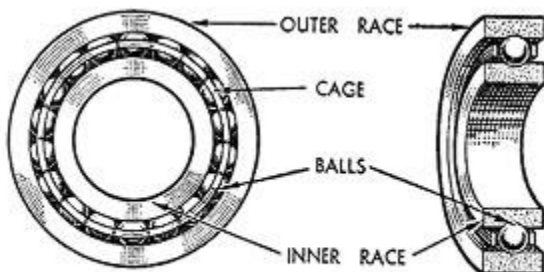
The following is inspired by some exchanges and observations on the subject of their beloved back axles which I share with you so that you will immediately put the car up on blocks and never start it again!! But first a reminder that the axles with which you are now very familiar, on which you bolt the wheels, need bearings to support them, These are massive things packed away behind the brake drums, filled with long life grease, carefully sealed and in the ‘normal’ life of a car should never need attention. But we are not dealing with ‘normal’ cars but ones still being driven despite their being well beyond their practical ‘use-by-date’! So what about the bearings – read on and see! Some observations, I should mention, on Factory practice were the result of research into archived records held by the Foundation.



A view of a diff inner axle bearing from the same car. More pertinently, 40 years of sludge developed

CARS BEYOND THEIR USE-BY-DATE

First let us talk about bearings. Nobody advised Ashley has ever heard a droning MKVI rear wheel bearing but many in the top end of the planet have had the whole lot lock up without warning. Assuming you survive this experience it is home on the back of a truck ignominious as it may be! I am still contemplating a Silver Dawn at high speed on a dry road having one wheel lock solid. While that is skidding along the drive from the engine would all be directed to the other wheel which being on a dry surface would not particularly want to increase its revs! I suppose one would instinctively whip the foot off the go pedal but standing on the brake – would that help? At least both



Ball race sectionised

wheels would be skidding; the brake servo would not be much help as that would stop. I need a first-hand account please!!!

THE REAR WHEEL BEARINGS

Typically the Factory had to go one better with their bearings, apparently buying kits of parts, re-hardening them to a greater depth, polished them more carefully and building them with tighter tolerances. These are recognisable by having hand engraving in addition to the maker's details and part numbers stamped on them and were quite conspicuous in the post-war manual gearboxes. The down side of this meticulousness (yes there is such a word you crossword freaks!) is that the tracks can



A dirty Silver Dawn axle

wear considerably without making any noise and the cages that carry the balls or rollers frequently disintegrate long before this happens. Bits of the broken cage then rub on the various surfaces and generate heat which melts out any grease that might be left and at that point, one may hear a squeaking; if you don't then the next step is for the bearing to lock up without warning.

Come back – I haven't finished! I know you were making a bee-line out to the garage to jack up a rear wheel spin it and have the whole family listen for noises! Well unfortunately it can be very difficult to tell if the bearing needs replacing just by listening. Certainly the wheel needs to come off, as any imperfect movement of the bearing is hidden by the

heavy flywheel effect of the road wheel. The brakes should be backed right off; both rear wheels off the ground and get you a decent stethoscope. If you still have doubts, strip the brakes unbolt the backing plate from the housing and pull the whole axle out. You can then spin the back plate and hopefully you will feel or hear problems going around. The sound if you hear it is like many dollar signs being crunched!!!

The more zealous among you may be contemplating simply taking the bearing off the axle and having a very close examination. Let me share a small experience I had some years ago with my first rear wheel bearing on an R Type Bentley. The hardest thing is getting them off the axle. First you have to get the collar off (see diagram part 3) which was a press fit. Careful drilling down this along the axis of the shaft weakened it and little pressure was needed to be applied to get it moving.

But then came the bearing (6). These are about 4-5 inches in diameter in housing (4). I had a plate an inch thick about a foot square, made up with a whole cut that would allow the housing to drop in so that the flanges would sit nicely on the steel. I used the press at a nearby Repco as it was large and they knew me. I started pumping and the pressure went up to about 15 tons. At that point I had to put an extension handle on and keep pumping. At 20 tons I noticed the people around me gradually retreating as the pressure rose. At 50 tons I put an even larger handle in the pump and most people were by this time backed up to the walls. At 52 tons there was a deafening crack which elicited a scream from everybody – me included, and the bearing moved.

Rear wheel bearing failure also occurs when condensation has entered the bearing, resting at the bottom where it erodes the track and balls. The rough balls then either carve up the tracks or cut through the cage. Persistent running with slack and partially failed rear wheel bearings will eventually cause the bearing to turn on the half shaft and within the bearing housing. Usually not realised, is that failed rear wheel bearings are one cause of failure of the main axle bearings and in practice the eventual scrapping of both the main axle case and the inner differential gear case. Conversely failure of the differential case side bearings will fail the rear wheel bearings. Each set of bearings support the half shaft (axle) at either end, indirectly through a bevel gear at the inner end, so a



Pinion bearing cage failure and the subsequent lockup

complete bearing failure at one end affects the other. It is surprising how long the axle will hold out, but the problem is that when it does go bang there is so much damage with attendant high costs.

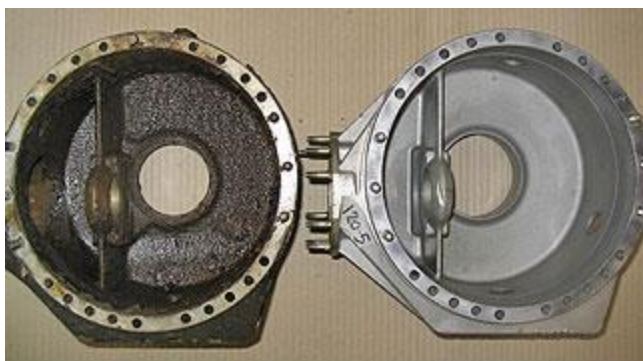
THE GEAR DEPARTMENT

Norman advises that back axle casings are also a problem because they tend to fill with crud, cutting off the oil supply to the bearings and jamming the spring (item 10 behind the side cage bearing in the Mark VI in the diagram below). At this point it doesn't take up the slack and the crown wheel and differential assembly rattles around in the housing causing a vibration that is difficult to locate. Then the tracks wear until suddenly the teeth are point to point and the assembly locks up.

The message to anyone with an early post-war car is that if the rear axle hasn't been overhauled do it or you could be in big trouble. Derby Bentley rear axles apparently were really weak and the Factory's records show that they often needed total overhaul at 30,000 miles! Mk VI rear ends are apparently better and Norman Geeson who has restored many of these units reckons about 80,000 miles between overhauls is necessary. He feels that his assemblies will last longer because they are all converted to taper rollers for the pinion and fitted with a modified breather and modern lip seal.

SEMINAL WHISPERS

The first sign that there is a problem in the gear department is catastrophic failure. In Ashley's case he was lucky in that a rear end vibration he had seemed to vary and wasn't cured by balancing wheels. His axle was retrievable and the pinion bearings were OK. The differential cage bearings however were totally worn out and the casing was packed with the detritus of years of extreme pressure oil components, dirt and general crud. The newly rebuilt rear end was amazingly smoother.



Dirty and clean

A view of a 40K S3 Continental diff inner axle bearing – more pertinently a 40 year old diff and the sludge developed.

Main axle bearings also suffer condensation erosion, usually on the right side where the inside of the vertical axle case (this part of the case cannot normally be seen) channels the water directly to the bearing. This noise seems to disappear when the axle is warm as the spring, which pre-loads the right-hand axle bearing (we're back to Mk VI's), allows the axle bearing to move in and out each time a worn section of the bearing comes around.

This spring can also move in sympathy to disguise a worn rear wheel bearing.

The pinion bearing assembly pulled from the diff casing in the same car. Note the build-up of crud.

The driver naturally believes the flat spots on the tyres have been relieved as the car attains more mileage. There is however a degree of vibration still present from the rear end normally detected through the floor pan, Unfortunately by the time a driver actually hears or feels either a damaged rear wheel bearing or axle bearing the damage is done.

PROPHYLAXIS - CHANGE YOUR OIL

Actually stripping these axles and replacing the bearings



A rejuvenated back axle



and cleaning out all the gunge on the way is the way forward, if only because replacement parts are becoming so scarce. In short, if the oil is changed frequently most dirt, except hard encrusted dirt, will be flushed out. This will be easier on the Clouds onwards because the interior of the axle case is smooth. Moreover the dirt will be removed slowly or not so fiercely as it might if a flushing technique is used and possibly there will not be the potential for further damage.

So when you realise you are talking about a litre of axle oil, why not resolve to change it every time you change the engine oil. Nowadays it comes in nifty little bottles with nozzles and takes literally a minute to put in.

OVER TO YOU

The essence of the above writings has been around for some time but there has been some reticence in publishing it thinking that it would frighten some owners. Sorry but get frightened I say, if you don't get on top of your diff who will?