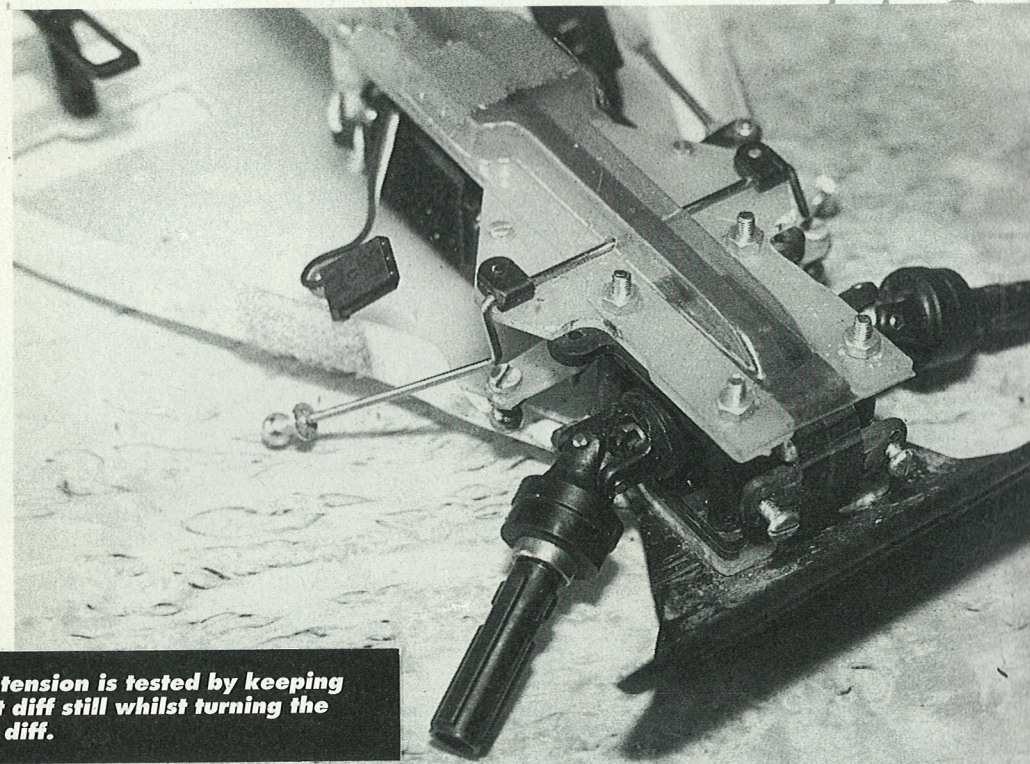


GET IN GEAR

Pete Winton gives a guide to the perfect gearbox.



Belt tension is tested by keeping front diff still whilst turning the rear diff.

low-cost cure for that too. The car is strong and the transmission effective; if you have a problem it is usually your fault, not the cars!

We took the opportunity to update our car with the latest Hex-drive differentials, and slipper clutch. The Hex-drive diffs are excellent and have performed superbly in the aforementioned Procat. The slipper clutch is not required for its primary task (to prevent wheel spin on acceleration) but because it reduces shock loads on the

transmission. More on this later.

A complete rebuild is expensive if it is done fully. What with the diffs and the belts, bearings, and pulleys, you could be staring £ in the face. The minimum required to do the job properly is a belt set (U194F £5.99), a pulley set (U610G £3.99) and two diff repair kits (U702B £4.95). This assumes the bearings are reasonable and can be cleared. For a full rebuild add new bearings (U724X £5.95) (for 4) and the Hex-drive diffs (2xU702B £4.95) are entirely your choice, neither being on advantage on the track, just better from a longevity point of view. For me, looking at the total cost of a seasons racing (entries, travel, tyres, spares, etc) the full rebuild is well worth the money since it saves time on maintenance and gives me complete confidence in the car, whatever the track, or my driving, can throw at it.

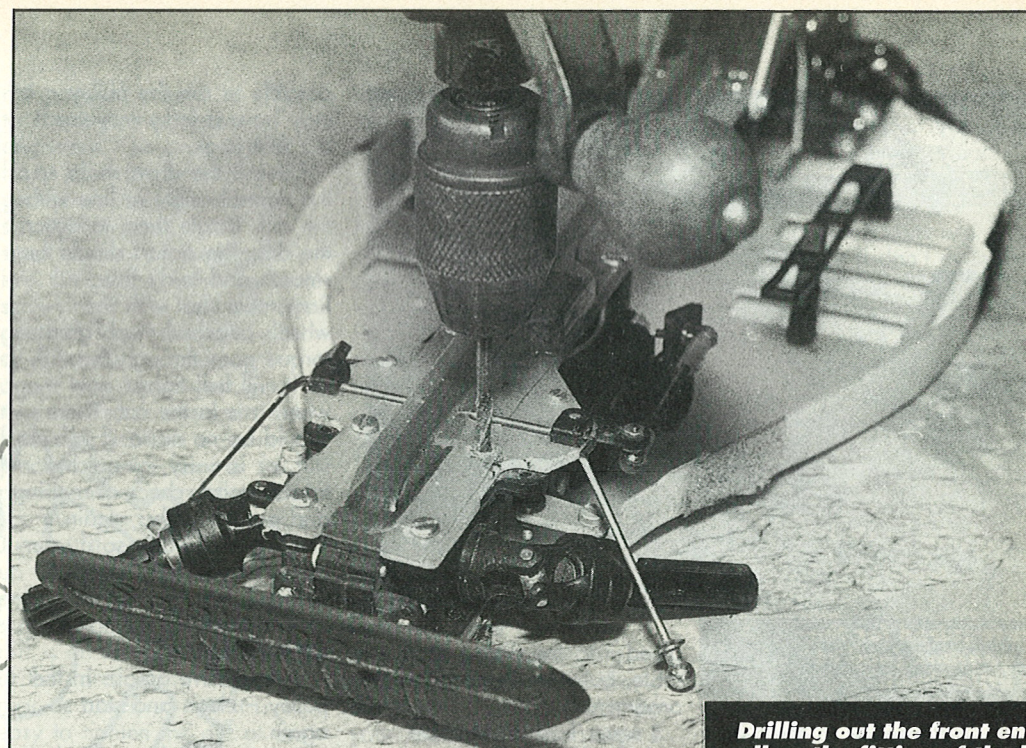
The total cost of our Hex-drive diffs, belts, pulleys, and bearings is around £45, with an extra £24.50 for the slipper. As we said, compared to total seasons costs and the ultimate peace of mind, strongly recommended.

Whatever you choose to replace, or rebuild, this is a total strip down of the car.

Remove all the rear suspension and front suspension. With the four corners removed, you are left with the spine of the car, from which all the electrics (motor, servo, receiver, cells speed controller) must now be stripped. Remove the spur gear and its drive pin. (I use old fins to put all the small parts in, one for the rear end parts, one for the front end parts. As well as preventing loss of the parts, it makes sure that everything goes back on the car. If there are any bits left, where did they come from?!!!)

Before stripping the car any further, now is the time to prepare the front end for the new gearbox clamp system. The light self tapping screws are replaced by four bolts which go from the bottom of the bumper to the top of the chassis (U641L £2.00). These

require a clearance hole through the gearbox clamps and the chassis, which is difficult to do with the parts separately. This is more easily achieved by drilling through all the parts at the same time. Use a 1/8in diameter drill (3.2mm to clear the 3.0mm bolt) and hand drill - not an electric, it is too unwieldy, and not a Dremel or Moto Tool it is too fast. Remove the self tapping screws from one corner at a time, both top and bottom. Place the car on a flat surface so it is properly supported and will not rock



Drilling out the front end to allow the fitting of the long through bolts.

during drilling. Drill carefully from top to bottom down the hole where you removed the two screws. (Obviously, the dining room table is not a suitable surface since the drill comes out at the bottom.

"Sorry Mum" is not going to go down too well???. Put one bolt through the drilled hole from the underside, and secure a nut and washer on the top. Do the nut up just a bit more than finger tight for now. Remove another pair screws, drill through, fit a bolt, and so on until all four corners have a bolt in them. Do the nuts up an extra half turn each and then check that the whole transmission moves as easily as it did before. The procedure requires care, but it is not difficult. The bolt will be better suited to our rebuild method than the screws, as you will see.

Strip the rest of the car down. Take the top and bottom chassis plates off, split the front gearbox, and disengage it from the long belt. Remove the left side of the rear gearbox and take out the differential, top shaft, and all the bearings. Check that each bearing is moving freely and if not remove the shields and clean it out. Insert

a pin between the outer race and the shield and lever it off, they come out quite easily. Once clean, add two or three drops of oil, and then pop the shields back in place. Make sure each bearing has one black and one brown shield.

Strip Time

Strip the differential and clean the parts. Any you choose to replace can be thrown straight in the bin. If they are no good now, they are no good as spare. The same applies to the top shaft (don't lose the pins!). When taking things apart, check carefully for any signs of wear or damage, and trace the cause. Re-assemble the top shaft. Remove the cover from the gearbox, the one that goes from the top, around the back, and under the car.

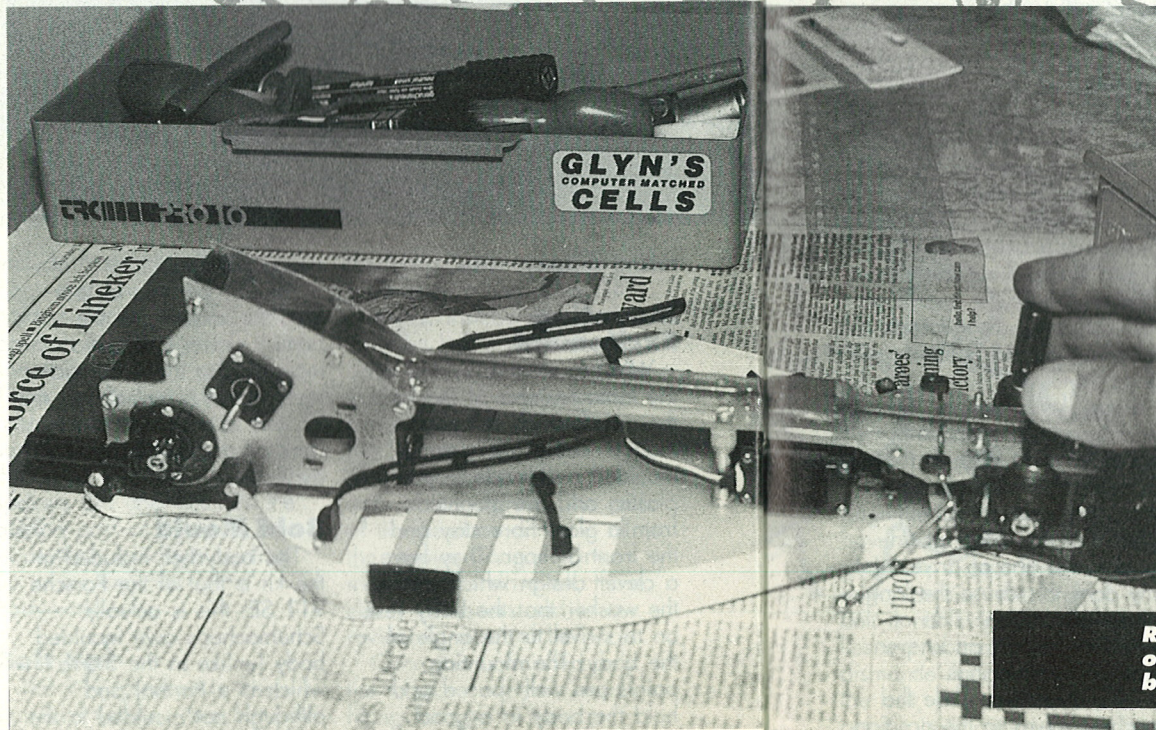
Total Rebuild

Rebuild the differential. The amount and type of grease you use is absolutely vital. The grease must be the Schumacher diff grease. This grease lubricates the parts, but is not a high pressure grease, thus it allows the balls to remain in contact with the thrust washer. Since it is only this contact which transfers drive from the motor to the wheels, any other type of grease (such as that used in car wheel bearing, LM or HMP type) is useless. The grease is only needed to help

the balls rotate in the holes, and form a limited shield against the dirt.

For the small thrust bearing under the head of the bolt, more grease can, and should be used, but again, only the Schumacher diff grease, fill each hole in the plastic cage with grease, and then put a ball in each hole. Assembles the thrust bearing. The grease oozes out of the sides and the excess is wiped off. You now have virtually a sealed bearing which helps exclude the dirt giving longer life.

On the main pulley, insert a ball in each hole, there are 14 on the Procat. (Note that if you reuse a pulley, it must be thoroughly cleaned in lighter fluid (petrol lighter



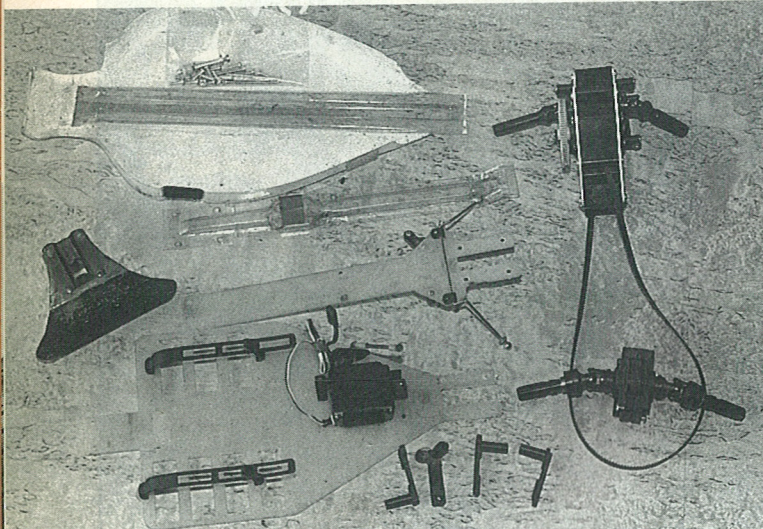
Right: the front end shows the one way clutches. Also note belt adjuster.

Would you like to know how to build a Schumacher cat/Procat gearbox so that it is bullet proof? Of course you would, it's a rhetorical question. Now is an ideal time to spend those dark and cold weekends getting the car ready for next season. RCMC presents the ultimate guide to a good gearbox which has resulted in our Procat racing ten meetings with faultless results, and its innards never seeing the light of day. Indeed, we have no intention of opening it up yet, we want to see how many meetings we can do before a problem develops.

The accompanying photos were taken during the rebuild of the RCMC Rally X car, which will be used during the winter at local and National

Rally X events. The car is now over one year old, and has taken quite a beating without any maintenance. Four minute Rally X racing over uneven terrain using hot (14 double) motors on SCR cells have resulted in a bit of belt slip (the long one to the front) and some decidedly rough differential action. The driveshafts are not bad, and the wheelbearings are still serviceable.

During 1990, I have seen a few Procats/Cats come to grief in the transmission department due solely to bad preparation. Make no mistake, if the car is correctly built and adjusted it will go on for many meetings without a problem. If there is an area for improvement, it concerns the stiffening of the two rear gearbox sideplates to prevent movement, and we have a

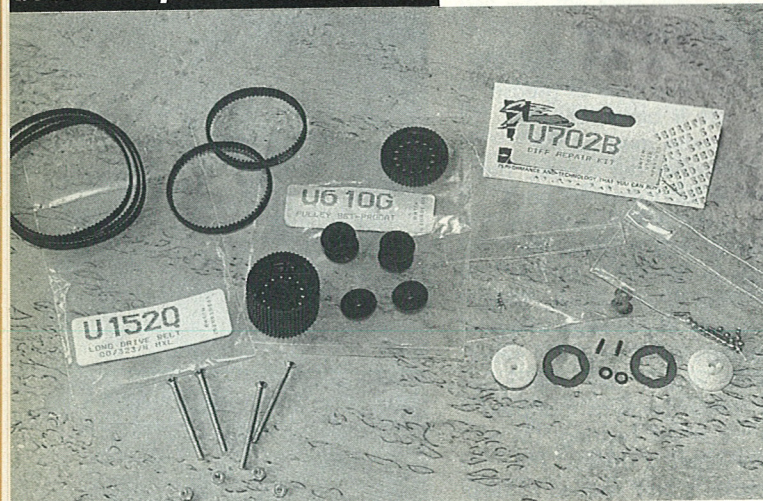


The parts required for the ultimate gearbox (and of course a little time).

fuel, eg Ronsonol) to remove all traces of dirt and old grease). Now, place a small 'blob of grease on each ball. We mean a small blob, and we mean one only on each ball. It need be no bigger than a pin head.

Now re-assemble your diff. Don't forget to replace the 3mm nyloc nut, they become worn and can come undone during racing when the nyloc insert is worn. When using the old type diff with steel washers, glue the washer to the carrier using Superglue Xtra (the gap filling type. Rough up the surface of the washer and the carrier with a 600 grade wet and dry paper to give a good key to the glue, and apply the glue to the carrier. Place the washer on a flat surface, and push down on the carrier. This gets the washer as flat as possible. (Sorry Mum I

The Schumacher diff repair parts and the new belts and super diff.



possible to run the pulley - it may have a jerky movement but that is ok.

Release the drive shafts to the normal angle in line with the diff. Rotate them to action the diff. The action should be smooth and fairly free. Remember that with the wheels attached much greater torque goes through the diff, so it will feel tighter now than when it is in the car. There should be no noise. If it feels stiff, or is noisy, or notchy, take it apart, check everything and put it together again. They always work, so if yours does not you have done it wrong.

glued it to the dining room table, but it makes a good ornament!!)

I never had any trouble with the latest 'sandpaper washer' idea for mounting the thrust washers, but if you don't like it then glue the washer to the carrier. The Hex-drive diff has no such problems. Assembly is easier if a smear of grease is applied to the carrier before the washer, since this stops it falling off at the vital moment during assembly.

Re-assemble the diff, and do the bolt up tight, almost until it locks. This will settle all the parts in place, and prevent any loosening of the diff during your first races. Now undo the bolt slowly until the pulley can be easily turned whilst holding the ends. Fit the drive shafts. Turn the drive shafts back at right angles to the diff until they lock the rotary motion. Hold both drive shafts in one hand, and try to turn the pulley with the other. Tighten the bolt until it is only just

suspension mounts. Fit it now, and do up the side screws. Rotate the diff to check it's free, and the top shaft likewise. Re-check the belt tension. When you are happy, replace the gearbox cover and do all the screws up reasonably tight. Check again for free movement in the diff and top shaft, make sure you have a little sideplay in both and then tighten off the screws.

I see no point in spending a fortune on an alloy gearbox centre (£82) 24 hole alloy belt tensioners, or posy black gearbox sideplates. I cannot believe that these products will move me any further up the qualifying list, or make my transmission last any longer. A properly assembled standard gearbox will wear out its diff balls/washers and belts in just the same time as an all alloy one, and a badly assembled alloy gearbox is just as easy to achieve as a badly assembled standard gearbox. It's your money to spend however, assembly of the front gearbox is a bit more time consuming. The main problem with the front gearbox is too much sideplay in the differential assembly. If this sideplay is removed the long belt always runs in the middle of the pulley which makes adjustment easier, and prevents the belt slipping as the diff pulley wanders from one side of the gearbox casing to the other.

Up Front!

Assemble the front gearbox as stated in the instructions. All the previous rules about the differential apply here too. Don't insert the long belt, just put the two screws in the front to clamp the gearbox together. Do up the screws so they just clamp the gearbox together. You will notice two things.

Firstly, if you hold a gearbox half in each hand and try to slide them in the opposite direction to each other, they move. You will notice that the diff is at an angle to the line of drive. Not only does this cause the long belt to ride on one side of the pulley, it puts an uneven force on the bearings.

Secondly, if you slide the gearbox halves to the position

where the diff runs at right angles to the line of drive, you can now push the whole diff assembly back and forth across the gearbox. For proper operation, the long belt must always be in the middle of the pulley, and stay there.

Taking the second problem first, we need to reduce the clearance in the gearbox to stop the side to side motion. Take the diff apart and separate the gearbox halves. If we remove material from the inner faces of the gearbox, we will reduce the sideplay to a minimum. Place a gearbox half face down on a piece of 60 glasspaper and rub it in a circular motion about 20 times. The glasspaper must be on a flat surface (piece of chipboard is ideal) and you must press evenly on the gearbox half. Now transfer the gearbox to a piece of 600 wet and dry paper and repeat the same circular motion ten times. This is to make the internal face of the gearbox smooth and give a good location. Repeat the same thing for the other gearbox half.

Re-assemble the front gearbox (without the long belt), slide the sides until the diff is at right angles to the split line of the gearbox, and carefully tighten up the screws to normal tightness. Now move the diff assembly from side to side. There should be less play than before. This process must be repeated until the sideplay is down to about .010in (about the thickness of a cigarette paper folded three times). At this level, you should just be able to feel a very small amount of side play.

You see why this is time consuming. If you overdo the sanding of the gearbox half inner faces, you will lock up the diff when the gearbox is assembled. If this happens, start again with two new gearbox halves! Perseverance here is worth it, believe me (tighten the diff as per rear).

Once satisfied with your alignment and sideplay, you have the perfect front gearbox, except for one minor detail - the long drive belt is not in place!! Herein lies a problem. If you dismantle the gearbox, insert the belt, and re-assemble (as per bit instructions) then it is

not possible to spin the diff to check your perfect alignment. The answer is to firstly prise the back of the gearbox open with a small screwdriver, and insert a small amount of Superglue into the gap. Remove the screwdriver and hold the gearbox together while it dries (check the alignment again too). Now when you take out the screws from the front, the gearbox stays in place. Prise the front of the gearbox open carefully and slip the long belt in sideways. Jiggle it through and line it up along the face of the pulley. Make sure that the screw head for adjusting the diff is on the right hand side of the car (looking from the rear as usual) so that it is easy to tighten the diff at the first rack test. Check that the belt is straight and not twisted and that the diff still moves freely. The car can now be re-assembled back to its 'spine' stage (ie without any suspension).

The front gearbox is clamped in place by the four volts we fitted earlier. The problem is that even with the new adjuster fitted to Procats (but not to earlier cars) the gearbox can still move back in a heavy shunt. Forget the adjuster, don't fit it. Look at the gearbox from the side. There is a gap between the rear leg of the clamp, and the boss surrounding the bearing.

If a spacer is inserted here, it will space the gearbox forward, enough to correctly tension the belts but cannot allow the gearbox to move back in a shunt. This idea was borrowed from Roger Cull, Rory's father.

On this particular car (and it varies from car to car) I used a piece of glass fibre plate (actually cut from the tool used to assemble the drive shafts in the kit!), and a piece of lexan from a body shell, to get the right spacing. Insert them into the space, push the gearbox back lightly against the screws. Do up the four clamp bolts and check the belt tension. Using various thickness of spacer, you can set the tension correctly.

Insert the spacers (always the same amount on each side), push the gearbox back against them (not too hard) and do up the bolts. Lock the

rear driveshafts, and then try to turn the front ones. If you try hard enough, the belt will always slip, so remember to look in your kit instructions for the right tension. I drill a small hole in the top belt cover, and use an Allen key to press on the belt. Providing the belt can be pushed down onto the chassis plate with a light pressure, and returns to its previous position, you are about right. The tension of the belt always goes slack under power, so having it slack now may make the belt slip under load. Check the tension in all rotary positions of the pulleys (they are never completely round) to make sure there are no positions where the belt tightens up too much. Set your tension in this position if that happens.

Brilliant, you say (you don't?) but the spacers could fall out. Not so - fast. When you re-assemble the front suspension, the plate holding the damper and the wishbones swivels round and closes off the space, fully trapping the spacers - now you say brilliant!

Back Together

The car should now be fully re-assembled, without the wheels. Remember the point about getting the belt to run in the model of the pulley? Fit a spur slowly by hand and watch what happens to the long belt as it rides over the front pulley. Does it ride exactly in the middle of the pulley? - you lucky ***! In most cases it won't it will fall off to one side. Slacken off the four clamp bolts, and holding the gearbox lightly against the spacers, move it gently to one side by pushing on the driveshaft. If the belt falls off to the right side, move the gearbox to the right. Clamp up the bolts again, and turn the spur gear. Again, take your time, but it should be possible to make the belt run in the middle of the pulley. If you find it impossible you have done something wrong, and may have to start again from scratch.

The long belt is not always perfect, so it may ride from one side of the pulley to the other in a complete rotation of the belt. This is OK, the

belt should run on the middle of the pulley most of the time, and wander equally to each side of the pulley. When the adjustment is satisfactory, check the clamp belts are properly tight (I don't overdo it, you may crush the gearbox) and everything is reasonably free - it will get better after a couple of meetings.

Fit the wheels and check your diff settings making final adjustments on the track. As for the slipper clutch, this is a great help in reducing the shock loads. Don't set the clutch in the track. Just do it up solid, and then undo the nut about 1/4 to 1/2 turn. This allows the slipped to slip under high shock loads such as are experienced after landing from a jump, or on very bumpy tracks. It helps reduce wear and tear on the belts and the differentials. I do recommend it for this purpose, but I realise it is expensive.

Long John

The point about the long clamp bolts is that they are much easier to use in making the fine adjustments necessary to obtain almost perfect belt tension and alignment. The spacers behind the gearbox boss mean the belt can never become slack, and that you can dispense with the gearbox adjusting plate on the Procat. The careful sanding of the front gearbox halves to eliminate sideplay prevents the long belt riding off the side of the pulley and slipping. The Superglue in the back of the gearbox prevents the halves slipping in a crash, preserving the belt alignment. Add that wonderful suspension mounting bracket from Pete's Awesome Products helps heat dissipation and preserves the rear gearbox alignment.

All these little things come under one heading - preparation. The art of preparation is knowing how to put the car together properly every time so that between rebuilds it is totally reliable. It does not matter how good the parts are (or are supposed to be) that you fit to the car, if you don't fit them properly they will always fail.