Renovering af vinkelgear

Angle-Drive for the Speedo – a simple part but a real nuisance

During the evolution from the TR4 to the **TR4A** a number of changes were made, that didn't work very well in the long term.

One of these was the addition of a small part with a bevel/spiral gear combination, to route the run of the speedo-cable through a right-angle. This carried on in the **TR5/6**.

These were commonly fitted to many cars of this period and there are about twenty different variants. Many from other marques will fit a TR, but some have different sized mating threads. So be careful if you are buying a used one!

They were originally made by Smiths Industries and part-number **BG2401-05** is the one used on Triumphs. This number is moulded into the casing, but is small and often gets worn away.

This is the unrestored original from my 4A:

My involvement with these drives started when a fellow member of the TR-Register forum asked if they could be repaired. I replied that I'd “have a go” and he sent me a few broken ones.

It seems that many TR owners have some of these laying about in a broken state, waiting for the day when somebody finds out how to fix them. After you have finished reading this, you may wish you had kept the one you threw out years ago.

This is **not** a part that's no longer obtainable. There are loads of reproduction items that are easily available. They cost anywhere from £30 to £50.

And that friends is the problem, at this price you really cannot reproduce this part to the same standard as the original. Later I'll show you the “short-cuts” being made to do it.

Smiths made superb job of these. Much better than any reproduction item I've seen. High quality materials and beautiful machining. But like many classic-car parts, there are a few design-weaknesses that lead to long-term trouble.

Opening the Drive

A common fault with these drives is that the flexible **wire-stub**, seen sticking proudly upwards in the photo above, is missing. Sometimes it's stuck in the transmission.

Any fault in the speedo-head or the long drive-cable that causes a jam, means that the twisting action will be concentrated in the wire-stub in the angle-drive. This is too short to absorb the twisting and just gets t**orn off**.

One of the drives that I had received was like this. I appealed to fellow forum members for a bit of broken speedo-cable, expecting that I could somehow graft in a piece to effect a repair. A piece was soon forthcoming and I acknowledge here the generosity of the forum member that sent me this.

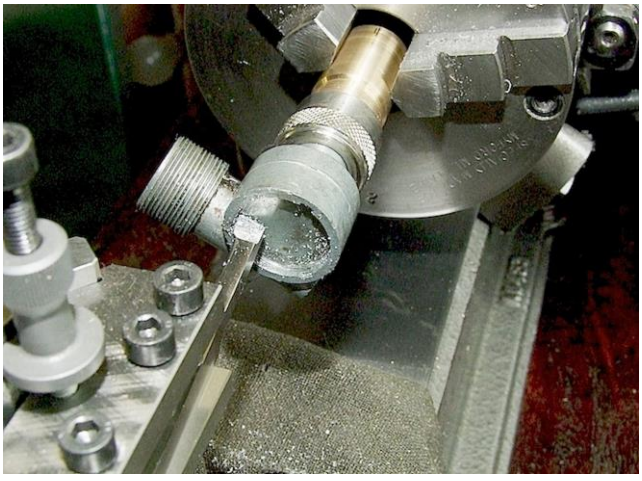
I set about opening up the drive, to find out how to fix in the new wire-stub. Smiths fastened these together by “peening”. The process deformed small areas of the body so as to retain the steel discs, that give the thrust-faces for the gears. You can just about see this, in three places, in the photo above.

Over time I've tried several ways to remove these peenings. All of them are better than the method used by a forum member who, later on was to send me twenty broken drives! Actually he sent a big bag of bits. He had simply hammered the gears out past the peenings. **Don't do this!** Later on you will see what happens when you do.

The peenings are quite small and the Mazak that forms the body of the drive is quite soft. On the first try I nibbled them away using a small cutter in a pillar drill.

This works fine and anyone with a pillar-drill could do this. You dont have to remove every trace of the peening, just **weaken them** enough so that the gear will tap out easily.

Here I am using a better method to get access to the main bevel-gear:



Doing this allows me to open the drive quickly, and cut a groove for a circlip to hold it together again, all in one operation. I do the same thing to get at the spiral-gear.

Note that I am using a jig to hold the drive securely. It does both gears and has other uses like checking the threads for damage:

When you have removed the peenings the gears tap out and everything comes apart:

You can see the broken wire-stub, which I have knocked out of the big bevel-gear, the spiral-gear, the thrust-face and the packing shims that set the end-float.

This is an original Smiths drive, note that even though this has probably been run for many thousands of miles, the gears show no sign of wear and all that is wrong is the broken stub.

The thrust washers are made by an accurate press operation and they are smooth and have flat faces. They are also hard and like the gears more or less unworn.

What else goes wrong

I've handled about thirty of these drives so far and so I have probably seen all the common faults.

Everybody that makes these has the problem of fixing the wire-stub into the bevel-gear. This is not easy, even Smiths had trouble doing this. The truth is there is no way to fix a flexible, springy wire to a solid, hard gear that does not generate a point of failure by **fracture, wear or fitting tolerance**.

Smiths crimped a ferrule over the end of the wire-stub, you can see it in the photo above. This has two ways to fail and I've seen both. The wire can "**screw-out**" of the ferrule or the ferrule can **slip** inside the bevel-gear. It's only a light push fit.

This is a particularly painful fault because it's often intermittent. Sometimes it "repairs itself" for a while, perhaps after reversing the car. Or it only happens when really hot, perhaps after a motorway blast.

Remember that to get at this part you will be removing both seats, the carpets and the tunnel. This is why it's important to try and get a drive that does not fail on you!

These drives have brass bushes for the gears to run in. These bushes are "cast-encastre", meaning they are in the mould already, when the molten metal that makes the body is poured into it. The brass is knurled on the outside so that it grips into the soft Mazak.

The amount of Mazak that is covering the brass is **tiny**. This is an obvious design error. It makes the stem between the knurled-nut and the main body very weak. This is why you **must not apply torque** to the main body, in order to undo the knuled-nut or hammer these about to get the gears out.

This is the result of such abuse, you can clearly see how thin these are, the knurling on the brass is grinning through. This will still work, for a while, but one day this will all come apart.

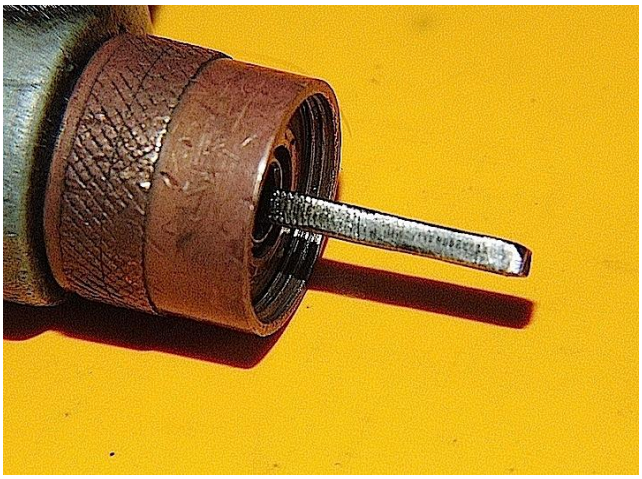
Here is another that has suffered abuse to its stem. In this case it has come undone from the transmission and has been running loose and rubbing on something. Again you can see how thin these are:

I fixed both of these drives with stem failure and wound up with a much stronger drive along the way. This is not really economic of course, but I did it anyway as a favour and to see if it would work.

The reproduction items are much the same. Reproducers are good at copying design errors it seems. So treat them all with respect in this region.

The wire-stub fits into a square hole in the transmission, its end being “made square” by grinding four flats on it. I ask you, grind away half the thickness of a wire to make a flat surface, really!

Here is one that has seen enough use that it **fails to “grab**” and the drive becomes erratic. This probably happens on cars without an angle-drive, the speedo-cables are made the same way:



Fixing the wire-stubs

The hole in the transmission where the wire-stub fits is, as far as I can tell, 1/8in across the flats. The bit of speedo-cable I was so kindly given turned out to be the standard 1/8in diameter. So I could not grind flats on it and get it to drive.

So I took a piece of 3mm square key-steel. drilled it to suit the speedo-cable and silver-soldered it on. This worked after a fashion but the wire was **weakened by the heat**, probably because of precious-metal embrittlement.

I didn't trust the result and had to think again. A forum member posted that he had fixed his drive, by grinding up an Allen key and jamming it in the bevel-gear. He claimed it had run for years. This was interesting, but Allen keys are hardened and tough to grind.

At this point I knew that 3mm key-steel was an almost perfect fit into the transmission. It's cheap, easy to get, very durable and yet is easy to work. The trouble is the bevel-gear has a 1/4in round hole in it and the Smiths ones are fully hardened and tempered high-carbon steel.

So I made this small brass part as a tight fit in the bevel-gear. It has 1/8in square hole in it, similar to the transmission, so a short length of key-steel will lock the parts together. These brass parts cannot be made economically by doing them one at a time. It's too fiddly. I make six at once and cut them off to size.

I added a **small O-ring** in order to retain the key-steel in the bevel-gear. This means there is a little freedom so that the key-steel “finds its place” in the parts, in the event that they are not perfectly in line. It damps vibration and means the key-steel is not just “rattling about” in there.

The rebuilt bevel gear looks like this, or rather a Smiths one does:

I made a batch like this and tried them out on willing members of the forum. They have been working fine for a couple of years now.

Oh those repros!

Here is the bevel gear from a well respected European manufacturer of reproduction parts. It's not too bad. The wire-stub is intact but it's been rotating in its ferrule. The ferrule is welded in place.

Lots of manufacturers try to do this. But such a weld is brittle and I easily knocked the ferrule out and repaired it like the Smiths one above. Note the much inferior finish on the gear-teeth compared to the Smiths one.

The gear-teeth get worse on the drives from the far-east. The teeth on this one have not been machine cut, they are just as they left the mould, when this item was cast. This one has had the ferrule knocked out also, you can see that there was no weld-penetration, just a suface mark where the weld was “stuck-on”.

I'**ll remind you here about the two seats, carpet and tunnel that you took out to fit this repro item**.

Enough of bevel gears and stubs, let's look at the spiral-gears. The lower one is a Smiths part, newly released from it's drive by the looks of it and the top one from a repro item made in the UK. Why do I think it came from the UK? I'll come back to that later on.

The top pinion came from a drive that refused to operate the speedo reliably. These pinions pick-up on the squared end of the speedo-cable. But they don't have a square hole. Not even the Smiths ones do.

Four dimples are pressed into them to approximate a square. This is OK provide you do actually make the dimples deep enough!

Note also the somewhat poor profile on the teeth.

When I first opened a drive I did not notice that there was supposed to be a hardened washer in between the spiral-gear and the drive-body.

Well there is on the Smiths ones and usually on other European repros. Do I find them on the parts from the far-east? What do you think!

Without this washer the ends of the spiral teeth gradually cut into the soft drive-body. When you open them they are often full of metal chips.

I use the nickname “blue-peril” for one of the most common reproduction items I come across. They twinkle blue seductively in your eyes because of the washer inside the knurled nut.

Just compare the spring-ring from one of these with the original item on the left. It's no wonder these usually have the nut loose in a bag when they find their way to me.

Circlips

One good thing, that I learnt from the reproduction parts however, is that you can fasten these drives together using Circlips.

The alternative would be to repeat the peening. But doing this operation by hand is a bit uncertain and there is a risk of damage to the drive-body.

The Circlip method works well and the grooves are not to hard for me to cut.

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