



Gearbox Overhaul - Part 2

The shafts were checked and reassembled in Part 1. This time everything is put back together. The last thing we did was to install new bearings in the end of the reverse-first speed countershaft gear. The countershaft components are shown in the next photo as a refresher.



Countershaft Gear Installation

The first thing is to slip the three larger gears and distance piece onto the splines of the reverse-first speed gear. The assembled unit is shown in the next photo.



The case is positioned with the front side down on the workbench. Both sides of the larger thrust washer (the disk with holes in earlier photo) are coated with grease and it is placed in position on the inside front of the case, making sure that the tab is in the slot. The grease on the back keeps the washer in place while the rest of the parts are positioned. The gear assembly is then slid into position (with the largest gear toward the front of the gearbox) followed by insertion of the rear thrust washer (also coated with grease). First problem: there was insufficient room to insert the rear washer. There should be an end float of .007 to .012 inches – and at this point the end float was negative.

The gears and washer were removed. The surfaces of the case behind the thrust washers were inspected and found to be very rough --- the front one looked like a woodpecker (or in this case an aluminum pecker) had worked on it. It appeared that it had been intentionally roughed up with a sharp punch --- maybe to reduce end float. Both ends were smoothed with a file. The front washer and gears were installed again. This time it was possible to position the rear thrust washer. The countershaft was inserted next and the gears were checked to make sure they turned freely. The end float was then measured between the rear gear and the thrust washer (see photo) and found to be insufficient. The rear thrust washer was then removed and the thickness reduced a few thousandths by first holding the steel back against the side of a grinding wheel and then leveling it off with a file. This brought the end float into specs.



Next, the gearbox is returned to the horizontal position and the reverse idler gear and shaft installed, making sure that the gear engages the reverse operating lever (that was not removed during disassembly). These components are shown in the next photo.

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The end of the shaft is wrapped with masking tape to prevent it from moving too far forward during the assembly process. The next photo shows the interior of the gearbox at this point. The masking tape on the reverse operating lever holds the reverse idler gear as far forward as possible to keep it out of the way during the rest of the assembly process. The countershaft is then removed so that the countershaft gears drop to the bottom of the case to provide clearance to install the mainshaft.



Mainshaft Installation

Next, the mainshaft with gears is inserted into the case through the top opening as shown in following photo. The wire is removed after the shaft is in position.



The outer ring of the third and fourth speed synchro hub is moved to the rear most position --- engaging the third speed gear. This is done to provide clearance with the front most countershaft gear. The mainshaft is then positioned as far forward as possible without interfering with that front most countershaft gear.

The center mainshaft bearing is now slid onto the mainshaft and driven into the rear of the case. The bearing should move freely on the mainshaft because the mating surface is pulled forward into the case. The bearing is driven into position using a punch on the outer race. Light whacks distributed around the bearing assure that it goes in square. Next, a plate drilled to match the bolts that secure the rear extension and with a hole for the mainshaft is bolted into position to hold the bearing in place. This plate and bolts could be used to press the bearing into case. That is not a good idea ---- a large force should not be exerted on a steel bolt being screwed into an aluminum case ----- it will cause excessive wear on the aluminum. The next photo shows the plate in position at the rear of the case.

The plate with threaded rod (another of those 1/2 inch rods left over from the church project) setting on top the case is used to press the mainshaft into the center bearing. The plate is bolted onto the front of the case using the front cover bolts. The rod is then screwed in so that it engages the center hole in the front of the mainshaft. At this point the first and second speed synchro cups are checked to make sure they are engaging the synchro hub assembly properly. The mainshaft is then pressed into the center bearing by slowly screwing in the threaded rod. The gears should be checked frequently to make sure that they are not in contact with anything and move freely. After the mainshaft is in position, the plates are removed and the washer and circlip to the rear of the bearing are installed. The final step for the mainshaft is to install the tool used to press the mainshaft out of the center bearing (see disassembly article) and press the mainshaft forward slightly so that the bearing rests snugly against the rear washer and circlip. This is necessary to make sure that the rear bushing end float measured previously is still there.



Input Shaft Installation

The input shaft is installed by driving the front bearing (with the input shaft) into the case using a punch on the outer race in the same way that the center bearing was driven into the rear of the case. Note that it is not a good idea to press the bearing into the front of the case by tightening the front cover into position --- that problem with wearing aluminum threads.

At this point the input shaft and mainshaft are checked to make sure everything rotates freely and the gears checked to make sure each has some end float.

Countershaft & Front Cover Installation

The countershaft is the next thing to be installed. The case is positioned face down and a large tapered punch is used to align the rear countershaft bearing and rear thrust washer. The countershaft should then slide into position. It might be necessary to return the case the horizontal position and align the front thrust washer before the countershaft can be inserted the last inch or so. Next, the locking plate that holds the reverse idler gear shaft and the countershaft in position is secured with a wedgelok screw.

The front cover, countershaft end cover and OD adapter plate are now installed using gaskets supplied in the overhaul kit. This was the first use of a 3/8-inch drive torque wrench my son-in-law gave me for Christmas a year ago. The manual specifies 20 ft-lbs or 2.8 kgf-m. The wrench is calibrated in in-lbs and N-m. Since there are 12 inches to the foot, 20 ft-lbs were quickly converted to 240 in-lbs, the wrench was set and the deed done. (No attempt was made to convert kgf-m into N-m.) The drain plug is also installed at this point out of fear that oil might be added later without first checking to make sure the plug is installed. A plug with a magnetic rod to attract metal particles was used.

A Type Overdrive Assembly

The A type overdrive had been disassembled some time earlier to make sure all parts were usable. I seem to recall that this was done at the time my daughter was working in the UK and was getting parts for me from Rimmer Brothers. One thing she got for me was a cast aluminum solenoid bracket assembly to replace the original that had the solenoid mount broken off.

The solenoid bracket assembly casting was broken when either installing or removing the gearbox. I don't recall whether it happen when the solenoid was bumped against something or it broke when I used the solenoid as a handle to lift the gearbox out. This casting is also broke on the OD unit in my TR250 and someone told me they had to replace the same casting on his TR250. The casting costs about \$75 so there's probably a message here someplace.

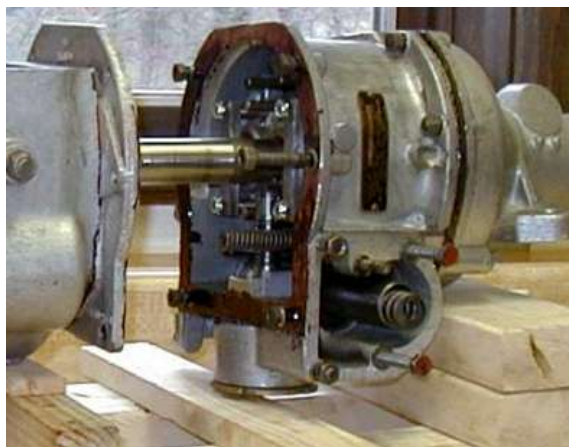
Ryan Miles had been anxious to help reassemble the OD unit ever since he obtained a similar unit for his car. Ryan came over just before noon for the one-hour job. The parts had been all cleaned up before he arrived. During this cleaning process I discovered that I had no idea how the parts went together. I had an old Haynes manual that gave instructions but they referred to the use of special tools that I don't have. This was after they stated that one should not take the unit apart unless the special tools are available. That was discouraging news --- that's what one gets for reading instructions.

We finally got the unit assembled properly at about 4:00 PM. Ryan claims that it was the fifth try that finally succeeded. Ryan provided many suggestions along the way, several of which were useful. Most importantly, he read the manual, which explained how to do several of the difficult steps.

Overdrive Installation

A gasket is placed on the rear of the gearbox and the OD adapter plate attached. Next, a gasket is positioned on the front of the OD unit and it is slid onto the mainshaft and attached to the adapter plate. There are 8 springs that stick out the front of the OD unit that must be compressed as the unit is drawn onto the adapter plate. There is also a cam on the mainshaft that has to engage the hydraulic piston push rod and the main shaft splines must mate with two sets of grooves in the rear of the OD unit. Before attempting to mate the units the mainshaft splines were visually aligned with the OD unit grooves and the mainshaft cam was aligned such that it would engage the piston at the low point on the cam. This position of the input shaft, the mainshaft and the rear flange were marked. At this point another five attempts were anticipated.

The next photo shows the OD unit in the mating position. Note the use of a gearbox stand to hold everything in position. This stand made the gearbox assembly much easier. The blocks under the OD position it at the correct height to engage the mainshaft. This photo was taken before all springs were placed on the studs in the OD unit. The unit slid into position on the first try. The unit was drawn onto the mainshaft by carefully tightening the nuts on the two longer studs while simultaneously rotating the rear flange back and forth slightly. The mainshaft splines engaged the grooves in the OD unit without difficulty. The whole process including adding nuts and lock washers to the four short studs and tightening all to the proper torque took less than 10 minutes.



The installation of the bracket assembly (also called a cover plate) had been postponed until the unit was mounted on the gearbox in the stand. It is much easier to work on the exterior of the OD unit when held in this position. I'll probably write a note about overhauling A type ODs after working on the one to be removed from my TR250. I'll explain that adjustment procedure then.

Installing Rear Extension (Non-OD Gearbox)

The rear extension must now be installed on non-OD gearboxes. First, the rear seal is pried out. Next, if the rear bearing is to be replaced, it is driven out the back of the rear extension using a long bar as a punch. The new bearing is driven into the rear extension using a punch on the outer race. A new gasket is placed on the back of the gearbox and the rear extension is then slid onto the main shaft. The bolts connecting the extension to the gearbox are then installed and tightened.

The speedometer gear and housing is installed next. Make sure that the hole in the housing is aligned with the hole for the peg bolt before inserting and tightening the peg bolt.

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In my never-ending pursuit of leaking oil, I found the little O-ring seal in the inside of the carrier was leaking on one of my gearboxes. The oil leaked from around the speedometer cable nut. Fortunately, that seal can be replaced without removing the gearbox.

Rear Seal Replacement and Rear Flange Attachment

Replacement of rear seal was deferred until the unit was stable on the stand. Unlike the front seal, the rear seal is pried out easily with a large screwdriver. If you examine the rear of the OD unit or the rear of the rear extension you'll see that the rear bearing has a smaller OD than the rear seal. There is a lip where the diameters change about a tenth of an inch behind the bearing. The new rear seal is driven in until it rests against this lip. The front of the rear flange is then greased and the flange is slid onto the rear shaft and secured with a flat washer and slotted nut (nylock nut on later versions) and torqued to ~120 foot-pounds. A steel bar dubbed the flange removal tool when we disassembled the gearbox is bolted to the flange to keep it from turning. A cotter key is then installed to secure the slotted nut.

Clutch Operating Shaft

The clutch operating shaft, fork and pin are installed next. Having the gearbox on the stand makes this job easy. The clutch operating shaft bushes should be checked, and if the fit is sloppy, drive out the bushes and install new ones. The gearbox front-end cover should be thoroughly coated with high temperature grease before the throw out bearing sleeve with bearing is slid into position. The sleeve is positioned such that the anti-rotation pin is at the top of the gearbox. The fork is positioned with the pins engaged in the groove in the throw out bearing sleeve (making sure that the flats on the pins are on the engine side) and the clutch operating shaft is then slid through the bushes and clutch fork. The shaft is then rotated such that the hole in the shaft and fork are aligned and the tapered pin is then installed. The pin should be tightened till snug (don't over tighten the pin, use a 7/16 inch open end wrench, not a 12 inch crescent wrench) and secure with a locking wire.

Gear Oil

The specifications in the Triumph Maintenance Manual call for API-GL4 Hypoid 90 weight for gearbox and OD unit. Currently GL5 oil is stocked in the grocery and auto stores. Some recent publications have suggested that an additive in the GL5 oil may attack the brass bushes in the gearbox and GL4 oil should be purchased --- at a price slightly higher than a good bottle of wine (at least the wine I drink). I've used the GL5 since the 80s (the oldest plastic bottle I had was from the late 80's --- not sure when the switch over from GL4 to GL5 occurred). My bushes have not deteriorated any that I can see so I'm going to continue to use the GL5.

Since writing the above I've given the subject of gear oil more thought. I've had my TR6 and TR250 for about 20 years and have changed the gear oil maybe twice. I expect them to be running for another 50 years so maybe I shouldn't take chances to save a few bucks. My first choice is now GL4 oil available from TRF (part # TRFGL4) for ~\$6 per quart, second choice Redline synthetic oil available from Moss for ~\$9 per quart and third choice Valvoline synthetic available from the local auto parts store for ~\$7 per quart.

The gear oil is poured through the open top. After adding about a quart, the front of the gearbox is tilted up to let most of the oil run into the OD or rear extension. It is then set it level again, and a few minutes are allowed for the oil to reach equilibrium. The oil is topped off then. This process is repeated until the stable fluid level is correct (above the bottom of the fill plug on the side). The gearbox capacity is about 1.2 quarts (non OD) or about 1.6 quarts (OD).

Top Cover

The top cover is installed next; making sure the reverse gear shift lever engages the slot in the shifter correctly. The top cover wasn't disassembled in this overhaul. The plan was to test the operation on the stand to make sure everything works properly. It will be easy to remove the cover at that time for any required repair. The gearbox in my TR250 slips out of fourth gear if the gearshift lever is touched slightly. This one was tested after the cover was installed to verify that that it locked into each gear. The test will be repeated later with the shaft spinning.



The previous photo shows the assembled gearbox. The only thing missing is a couple switches in the top cover and the wiring harnesses for the backup light and for the OD solenoid. They're around here someplace --- unless the spouse threw them out.

At this point I knocked off for the evening. The next morning I found a puddle of oil under the gearbox. The seals weren't leaking (yet) --- the puddle was under the big 2-1/2 inch brass OD drain cap. My first thought was that the GL5 ate a hole through the brass cap during the night. Upon further inspection I found that the oil was leaking around the cap gasket. The gasket under the cap disintegrated when the unit was disassembled. A new gasket had been purchased plus a spare for the unit in the TR250. There was a vague recollection that there may have been two gaskets on the cap. Apparently the cap ran out of threads before the lip tightened on the gasket firmly enough to make a seal. A second gasket was added, which fixed the leak.

Next, an adapter was fabricated that attaches to the input shaft so that a half-inch drill can be used to spin the gearbox. The next photo shows Ryan winding up the gearbox. The OD was tested to make sure it worked (it did) and to also checked for unusual noises, etc. The final thing to check was the OD solenoid. This required dragging a battery to the workshop. This test was also successful.

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At this point excuses to not pull the gearbox on TR250 are exhausted ---- maybe the next warm day.

More on Rear Seals

Several weeks after writing the above I took the engine and gearbox out of my '76 TR6 in preparation to taking it to paint shop. A few days later I noticed gear oil under the rear of the J type OD unit. I was also getting together parts for overhauling the gearbox and A type OD that I had pulled from the TR250 and replaced with the freshly overhauled gearbox described above. So ---- I needed to order a rear seal for the A type OD and one also for a J type OD.

The TR6 Catalog Volume I from TRF lists the following original part numbers:

- 146129 – rear seal non-OD gearbox,
- 513898 – rear seal A type OD,
- NKC39 – rear seal J type OD.

The 513898 is no longer available. Over the years I've seen both the 146129 and NKC39 specified as a replacement for the 513898. Since I had both A type and J type ODs as well as a non OD gearbox available out of the cars I decided it was a good time to compare the seals. I ordered a NKC39A (replacement for NKC39). When it arrived I found the outside shell of the NKC39A to be about 1/3 wider than the 146129 but of the same outside diameter. The unstressed inside diameter of the NKC39A is about .03 inches bigger.

The flanges were then compared. I pulled the one off the J Type in the garage. I had loosened the retaining nut before I removed the engine & gearbox from the car so it was no effort to take off the flange. I then noticed that the oil was leaking between the shaft and inside of the flange. Dumb! The flat washer under the retaining nut seals this (when the nut is tight). I didn't need that NKC39A seal after all.

I labeled this flange with a J so I wouldn't mix it up with the flange from the A type OD that I labeled with an A. After looking at them together it was clear that I wouldn't get them reversed – see next photo.



All dimensions of the two flanges were measured and found to be identical except for the inside that mates with the shaft. The parts of the cases that mate with the outside of the seal were also found to be identical. There was a small difference in the distance from the back lip of the case to the backside of the shaft bearing but not enough to make any difference with the seals. The flange off the non-OD gearbox was then examined found it to be identical to the flange from the A type OD.

One thing is now clear --- either seal will work on the regular gearbox or either type OD unit.

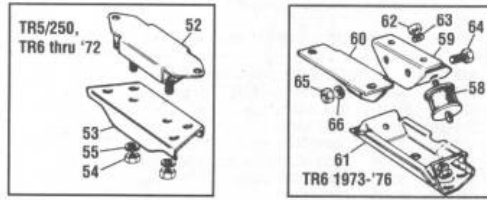
Gearbox Mounting

Working on both types of OD units at the same time brought to mind the different mounting arrangements. The non-overdrive gearbox and the A type OD units use the same rear mounting. The design of the J type overdrive is somewhat different. There is a three-inch long adapter attached to the front of the main part of the J type OD. I think this was done so the OD could be self-contained with the 8 springs inside. The OD unit was probably shipped with the adapter installed so the mechanic wouldn't have to fool with the springs and the possibility of springs getting lost. The following photo shows a gearbox with a J type OD that can be compared with earlier photos of the A type OD.



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Moving the main part of the OD unit 3 inches to the rear required a different rear mounting arrangement. The change was made in 1973 when the J type was introduced. Different brackets welded to the frame allow a new gearbox mount cross member (#61 in following sketch from Moss catalog) to be mounted in a forward position for a regular gearbox or A type OD and in a rear position for the J type OD. There is a bracket (#60) that is also used with the gearbox mounting adapter (#59) for non OD gearboxes and A type ODs. The gearbox mounting adapter attaches directly to the J type OD and is shown in position just ahead of the rear flange in the previous photo.



What does all this mean? First, the later cross member is much more difficult for one person to remove. The parts have strengthening lips that make it impossible to remove the nuts from under the car while simultaneously holding a wrench on the bolt heads on the top of the mounting cross member. Second, a J type OD can't be used on a pre 1973 frame unless the brackets welded to the frame are removed and replaced with the later design.