Classic Mini (1959 – 2000)
Transmission First and Third Motion Shaft Fastener Removal and Replacement

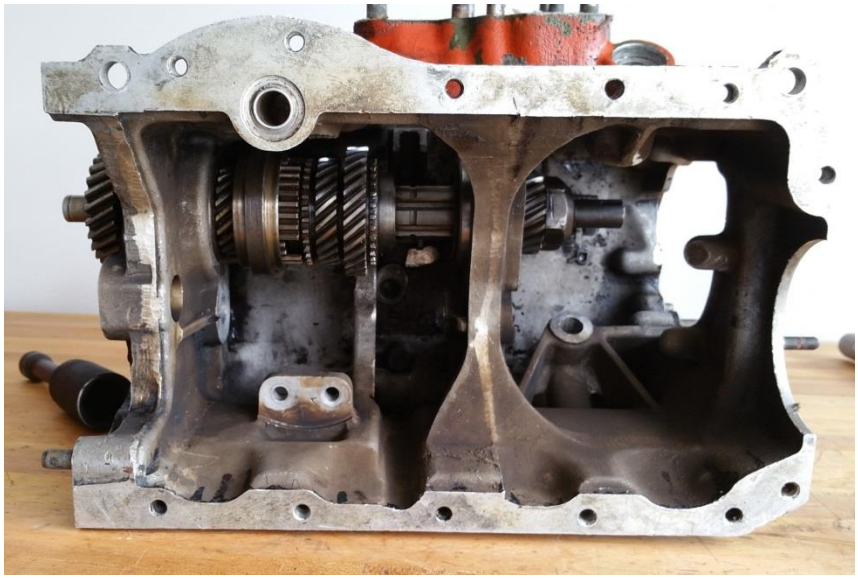
Purpose

The method proposed here to remove and replace the first and third motion shaft fasteners imparts near zero loads on all of the internal bearings in a classic Mini manual transmission. It is based on the principle of reducing or eliminating static loads on roller element bearings during any assembly process. It is comparable with pressing the outer race of a roller bearing into a bore, or pressing the inner race of a roller bearing onto a shaft, in order to avoid static loads through the roller elements in the bearing during assembly.

Method

Engage 4th gear, and only 4th gear, leaving the 1st and 3rd motion shafts locked together, but free to rotate in the transmission housing. The laygear doesn't even have to be in the gearbox. For example, in Figure 1:

Figure 1.



The 4-3 hub is engaged in the 4th gear position, and the 1-2 hub isn't even present.

Assembly

Put the 1st motion shaft input gear and locktab and nut, and the 3rd motion shaft final drive pinion. locktab, and nut, together, clean, and finger tight. To torque the two fasteners, since the torque requirement is the same for both, all one has to do is prevent one end from rotating, and apply the

wkeithadams.pe@gmail.com

specified torque to the other, simultaneously setting them both. The loss of torque through the unloaded bearings is negligible. This requires no additional or special tools, although some means could be devised to make it easier.

Apparatus #1

Have a friend hold a breaker bar on one end, and torque up the assembly from the other. This sounds more like a wrestling match than a "method," as 150 ft-lbs is rather much.

Apparatus #2

Place a breaker bar in a sturdy vise attached to a sturdy bench, and torque up the assembly from the other end. Figure 2 and Figure 3 show what that might look like:

Figure 2.

Figure 3.

This is the assembly method that I have been using until now. Not everyone has a large vintage Columbian vise handy.

Apparatus #3

If one does not have a large vise, a brace could be fabricated to anchor a socket to a bench on one end, and maybe stitch together a tool rest at the other end, to make the job easier. These would store in a toolbox, but still require a sturdy bench. The anchor or reaction end could look like this:

Figure 4.

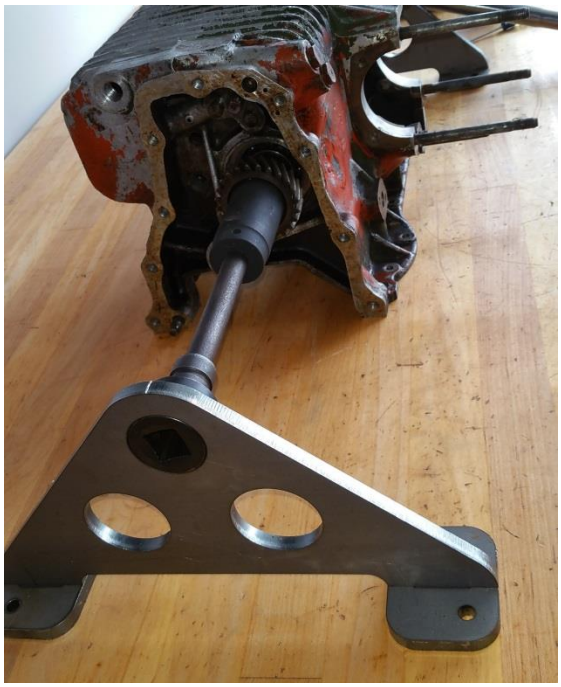
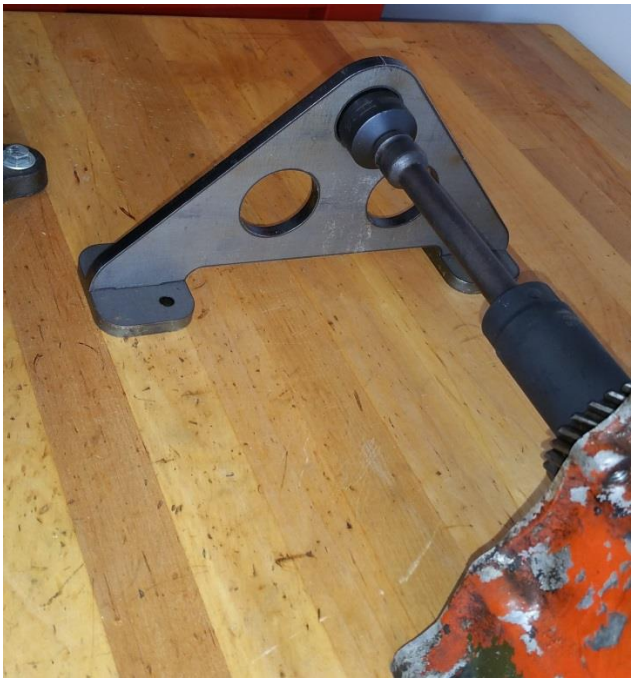


Figure 5.



The "rest" end could look like this:

Figure 6.

This kit would line up the sockets with the work nicely enough, but would still require a sturdy workbench.

Apparatus #4

If one desires to make the apparatus portable, the reaction torque could be run through a telescoping square tube setup, so that no sturdy table would be necessary. It might look like this:

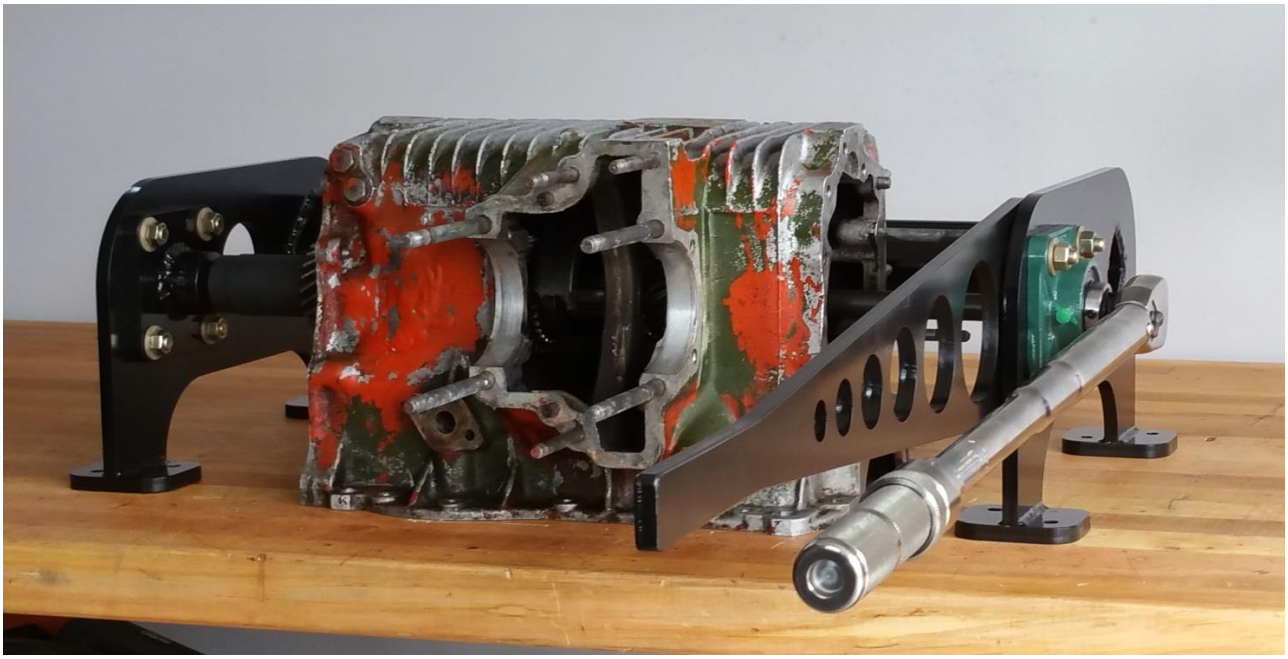
Figure 7.

Figure 8.

The flange bearing provides a tool rest for tightening and loosening the assembly. Together, it looks like:

Figure 9.

Figure 10.



wkeithadams.pe@gmail.com

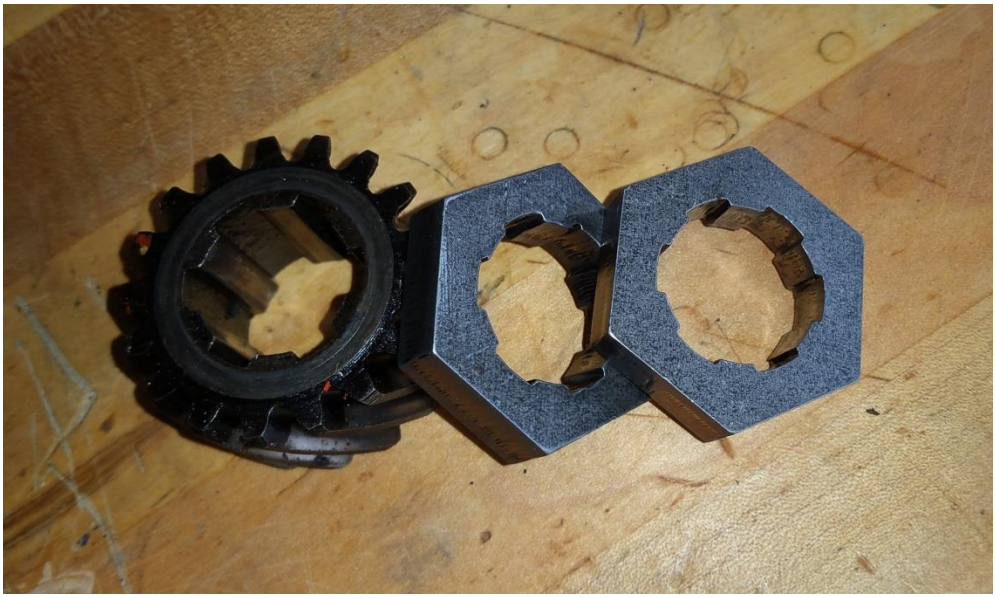
Figure 11.

The proximity of the reaction arm handle to the torque wrench (or breaker bar) saves you from having to do anything to immobilize the transmission case, since no loads at all are going through it.

Disassembly

A “benign” disassembly is not quite the same. The application of a loosening torque on one side, while preventing the other end from rotating, will rarely, if ever, loosen both fasteners at the same time. The answer is:

Figure 12.



The pinion is shown for scale. The hex/spline adapters fit both 1st and 3rd motion shaft splines, and are 1.5 inches across the flats. Whichever fastener first loosens, remove it, pull the gear, slide on the hex/spline adapter, and loosen the other side. In place, on the 3rd motion shaft, it looks like:

Figure 13.

wkeithadams.pe@gmail.com

A deep 1 ½ inch socket is necessary to reach around the speedometer drive extension. The original intent was to cut and weld old gears to salvage the splines, but laser cutting, while not precise enough for cutting high speed gears, is up to cutting zero speed splines from flat stock. These adapters are hot rolled steel, so they are soft enough to not mar the splines.

The hex/spline adapter could also be used if a different assembly torque is desired for each of the 1st and 3rd motion shaft fasteners. First, use the hex/spline adapter to hold the end with the lesser torque requirement, assemble the side with the higher torque, and torque to specification. Then remove the hex/spline adapter, assemble the end with the lower torque requirement, and torque to the lower of the two values through the previously assembled side.

Summary

1. For assembly, no additional tools are necessary.
2. Absolutely no bearing life is consumed during the assembly process.
3. Only a simple hex/spline adapter is necessary for disassembly.
4. A simple hex/spline adapter can be used for assembly for those who have figured out that the 1st and 3rd motion shaft nuts should be torqued to different levels.

Versions

2016.04.23	First distribution
2016.04.26	Change Columbia to Columbian vise

wkeithadams.pe@gmail.com