

## Removing Play from the Burman-Douglas Steering Box

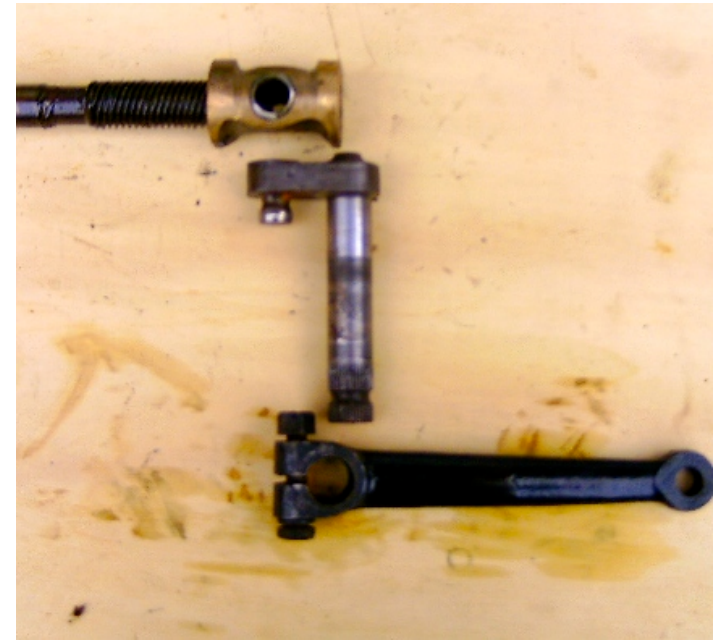
Aside from a very few early 4-wheeler cars which had a reduction gear mounted halfway down the steering column, all Morgan Series 1 cars were fitted with a Burman-Douglas worm and nut steering box. Variations of this box were fitted to quite a number of contemporary British vehicles.

The system involves a thread, usually six start on Series 1's, but sometimes five start (mainly left-hand drive), machined on the end of the inner column, carrying a bronze nut. Right hand drive cars have a left-hand thread and vice-versa. There is a hardened steel bush screwed into the top of the nut using a special process. A peg at the end of the "L" shaft at the top of the rocker shaft engages in this bush. As the inner column turns, this peg transmits the up and down motion from the bronze nut via the rocker arm, to the steering drop arm attached to the bottom of the rocker arm shaft. The drop arm is attached to the rocker arm shaft via a splined shaft and a pinch bolt. (NOTE: some cars may have been subsequently modified). The shaft of the rocker arm rides in two bronze bushes, the top one of which has a diagonal cut for about three-quarters of its length to provide clearance for the bronze nut.

The only provision for adjustment is for end float, and is via two large thin nuts at the top of the column under the steering wheel which bear on a ball race. The bottom of the inner column is free-floating, location being provided by the bronze nut, which is a sliding fit inside the box casing. The system on the Series 1 cars, with the common six start worm, gives one and three-quarter turns lock to lock.

This steering box continued in use, with some minor differences, on the Plus 4 cars, from 1950 up until around the 1954 season. It was then replaced with a Cam Gears Ltd steering box, which continued in use on all Morgans up to the advent of the Gemmer and rack and pinion systems. The Cam Gears box, while externally somewhat similar in appearance to the Burman-Douglas, is quite different internally. A cam and peg design, it is nothing other than the familiar old Bishop cam device, actually an earlier and cruder invention than the Burman-Douglas which it replaced!

The Burman-Douglas box can only be tested for wear properly on the car, ie under load, all connected up, with the wheels on the ground. First, make sure there is no end float, and that the box is securely located and fastened. Next (making sure there is a container to catch the oil) take off the end and top covers on the box and have a helper juggle the steering wheel while you (the "foreman") check for play between the worm and the nut (ie for wear in the thread) and between the nut and the side of the box. Check also for wear in the bushes (ie movement in the rocker arm shaft). It is extremely unlikely that there will be any wear between the peg and the hardened steel bush in the top of the bronze nut. If you are desperately unlucky, the bush may be loose in the nut,



*Internals of the Burman-Douglas box. This shows the worm machined on the end of the inner steering column, the bronze nut which screws onto the worm, the rocker arm and peg which engages with the hardened steel bush in the bronze nut and the steering drop arm which attaches to the bottom of the rocker shaft*



in which case I suggest that you look for another nut, as I am still struggling for a way to make these stay permanently tight again. The drop arm must also be tight on the bottom of the rocker, of course. Note that there is an oil seal above this, usually of rope or felt, held in place by a washer, with box housing peened over to secure it. This seal can be replaced with a modern neoprene one.

Something to watch for is that some replacement nuts are undercut on their topsides where the steel bush goes. If you strike one of these, the peg can jump out of mesh when the wheel is turned, and you will have either to add an adjuster screw to the top cover to hold it down and/or pack out the bottom of the rocker arm for the same effect.

Address wear in the thread as follows. Clean the nut thoroughly (Prepsol or similar) then tin the inside of the nut lightly with solder. Grease the thread on the shaft with a good axle grease (don't use WD 40 or similar as they may well flash) and screw the nut on, about halfway along. Melt babbitt metal, heat up the nut, and pour the molten babbitt metal down the bush hole, rotating the shaft until metal appears at the end of the nut. Keep rotating the shaft as it cools down to prevent binding.

This will get rid of the play in the thread, but note that the effectiveness of the repair may be limited if the thread on the shaft has much "hourglass" wear on it.

Play between the nut and the side of the box is addressed similarly ie by building up the sides of the nut with babbitt metal and machining to be a tight sliding fit in the box. Addressing other areas of wear, eg in the drop arm shaft bushes, should be straightforward.

On reassembly, "work" the bits together using moly compound and clean up thoroughly – remove all metal "dags", filings etc. Best to assemble and disassemble several times to ensure everything is scrupulously clean.

I have found the above effective in reducing play from around eight inches at the steering wheel circumference to around three quarters of an inch.

A note of warning – cultivate smooth driving habits and don't "yank" at the wheel. Never, on any car, try to operate the steering with the vehicle stationary.

By John Merton (based on an article first prepared for "The Morgan Ear" in 1990).

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*Top covers. Some replacement bronze nuts (they were available from several different manufacturers) had an undercut hardened steel bush. The cover on the left shows the later addition of a screw in bolt to stop the peg on the rocker arm jumping out of mesh with the bronze nut as the steering wheel is turned.*





*Dodgy practices. The first photograph shows that someone has added bits of shim sheet to try to take up wear between the bronze nut and the steering box casing. The second photograph, likewise aimed at reducing play caused by such wear, has involved welding spots around the inner column and filing them down to make the column a tight fit in the outer column.*