Steering Box Rebuild:

Introduction:

Please forgive my terminologies if not 100% correct, but I am learning all the time and always happy to be corrected; however, here is my attempt at explaining the rebuilding and processes I followed on the rebuild of the steering box on my 37M8T after the steering wheel developed quite a bit of play/slack. The car would wander a little while driving, and keeping a straight line required constant adjustments. The rebuild was done under the instruction and watchful eye of ever-helpful grand master Yoda-Eddie.

When looking under the car one could also see the play on the drop arm, and the steering wheel had about 3 inches of play before engaging. Sadly my photographs do not follow the following narrative 100% at every stage, I took as many pictures as I could and ended up covering wife's camera in black grease; its light grey strap was black at the end of the day—dog-house for me... but what's new?

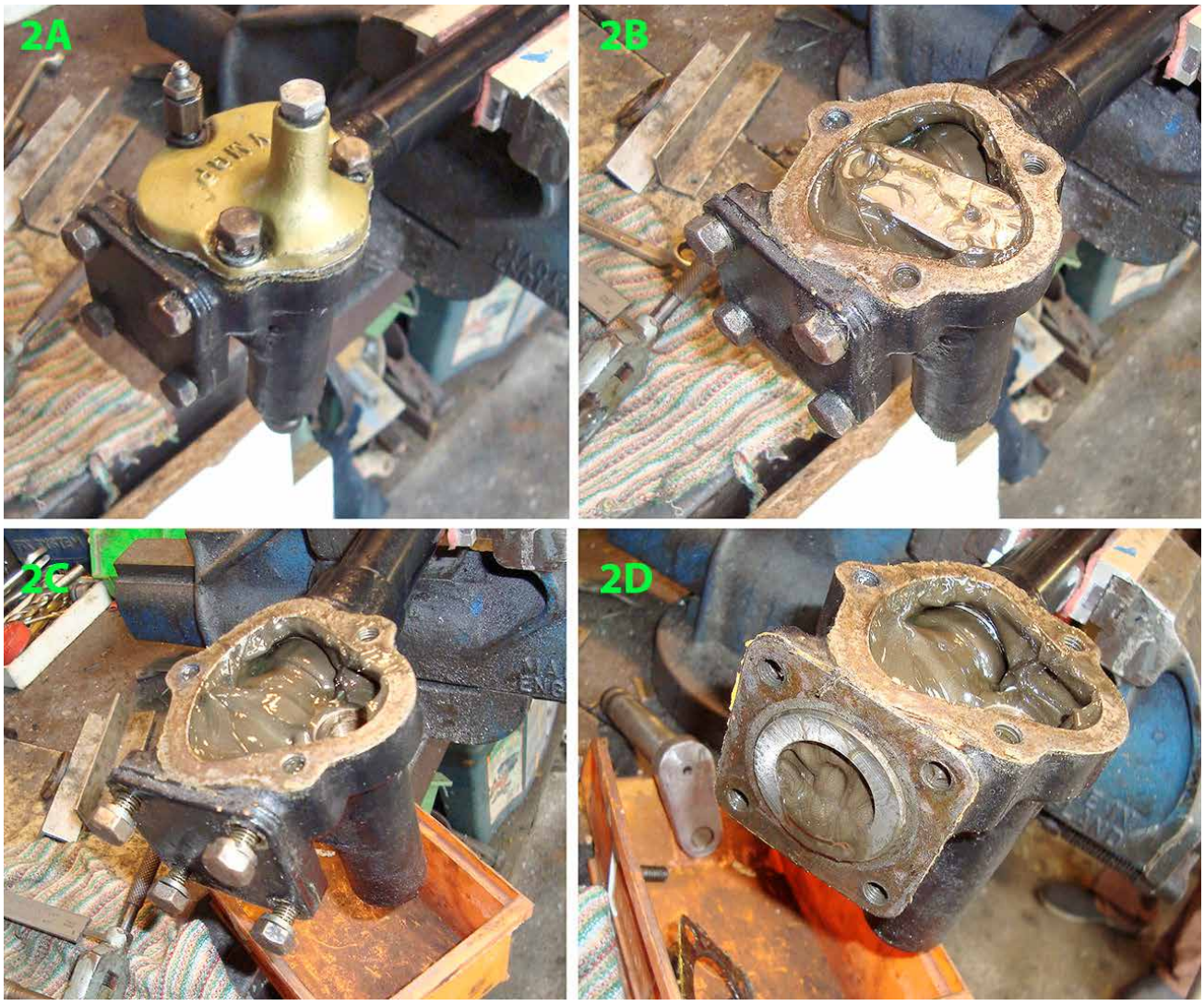
Prior to starting, the new items obtained for this rebuild were; a new oversized sector shaft, new bearing races x 2 and bearings x 2; new shims; bushes x 2 (the bushes were eventually not needed).

Picture 1: Shows the play in the steering wheel prior to starting.

Stripping down the steering box:

After removing the steering column from the car, the first stage was to strip down the box on the bench. As you can see my column has an adjustable top plate, not original, which was first to be removed with the few shims that were in place behind. Second was to lift out the sector shaft with a light tap from underneath. This had play in it and there was clear movement in the bushes. Undoing the 4 bolts on the bottom bearing end plate was next, and removing the shims that sat behind.

Picture 2: Shows the stages mentioned above.



After removal of the above, the bottom bearing race and bearings came out easily, allowing the inner steering column with worm gear to be pulled right through and out. This left the top bearing loose on the inner steering column, easily removed when the inner column was completely extracted from the outer column. This just left the top bearing race to be removed from the back of the box housing, which was done with the persuasion of a screwdriver down through the top plate opening.

Picture 3: Shows these steps.

Following all of the above, the now empty steering box and column, inner column and worm, top and bottom plate all had a thorough clean in thinners to remove all muck, dirt and grease. Box stripped and cleaned, quick and simple. Inspection of the worm showed it was in good condition and only needed a light cleaning with a carborundum stone.

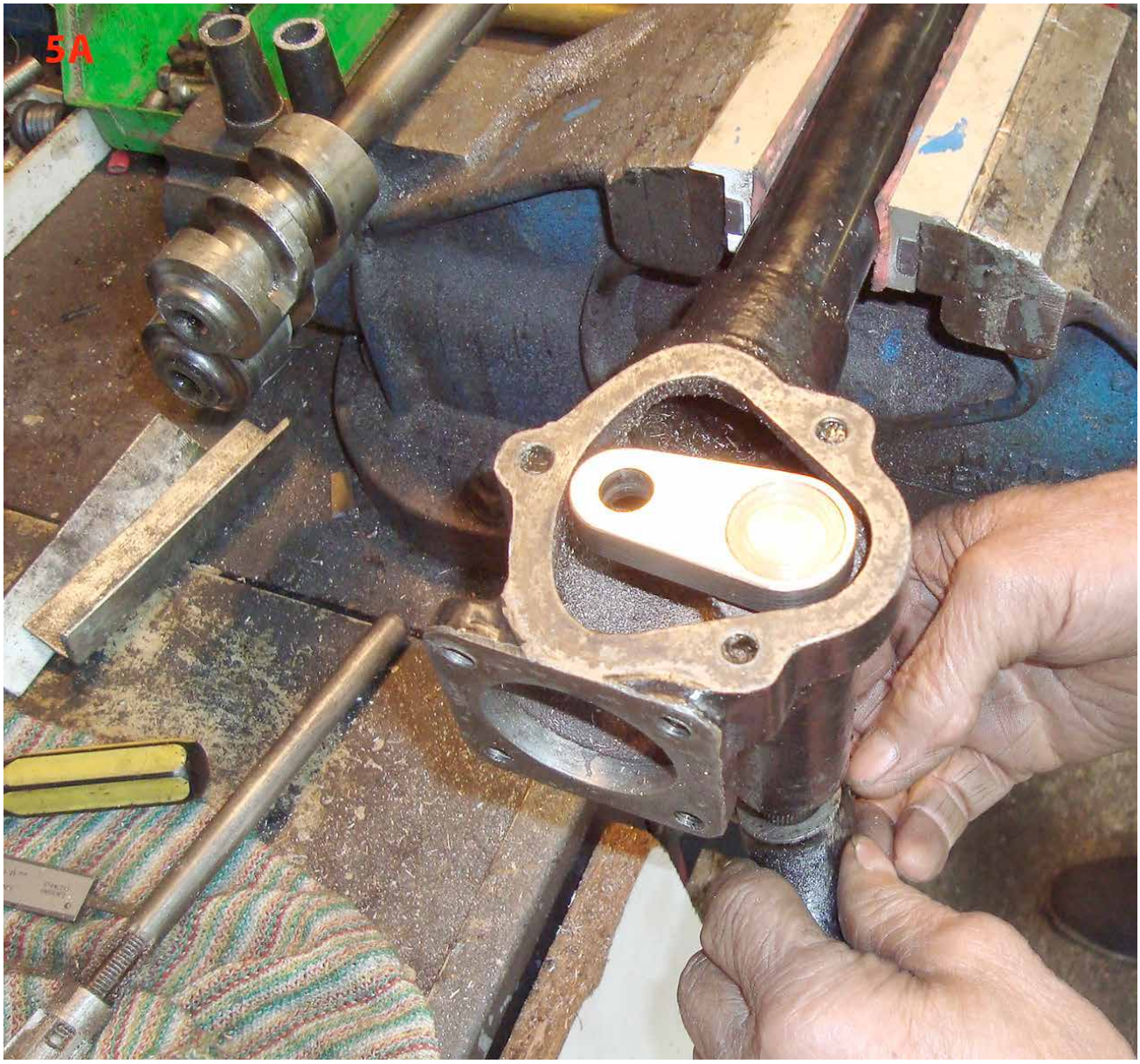
Reaming in new oversized sector shaft:

Once clean, it was fortunate to find that my box had been fitted with bushes for the sector shaft, which had obviously been replaced at some time. These bushes had sufficient material left to allow them to be re-reamed to take my new oversized sector shaft; saving the effort of having to drift out old bushes or machine and fit a new set. However, next came a very long but valuable lesson on using an adjustable reamer.

Picture 4: Shows centring the reamer with a tapered collar underneath, followed by reaming bottom bush.

My new sector shaft was 0.020" oversized; so the bushes needed reaming. Bit by bit, very slowly the top bush was reamed till the new sector shaft could be fitted snugly. This took me 90 minuets and about 30-plus incremental passes, but better to ream slowly and check each and every time than cut too much, then have to fit new bushes and start all over again. Once one bush was done the box was turned over and the bottom bush could be reamed in the same way, but slightly quicker, by backing off the reamer for the first cut, knowing with confidence it would be smaller than needed for the first cut/pass.

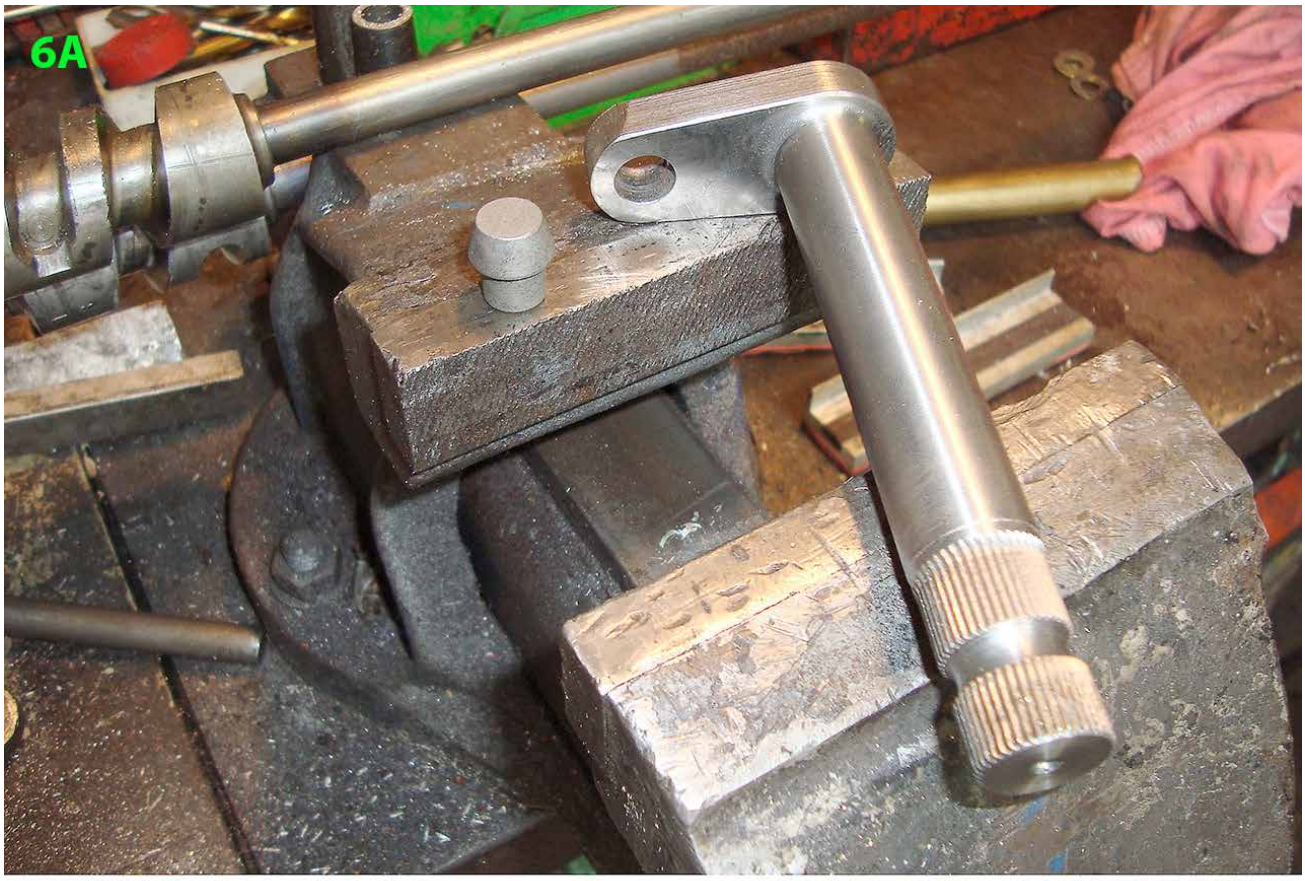
Picture 5: Shows the new sector shaft finally located for test fit after reaming.



After checking if the new sector shaft had full movement inside the box, a small adjustment by way of a bench grinder was needed on its top edge as it fouled slightly inside the box, just above the worm peg hole. After this small adjustment, and refitting the sector shaft, full movement each side was attained with no fouling.

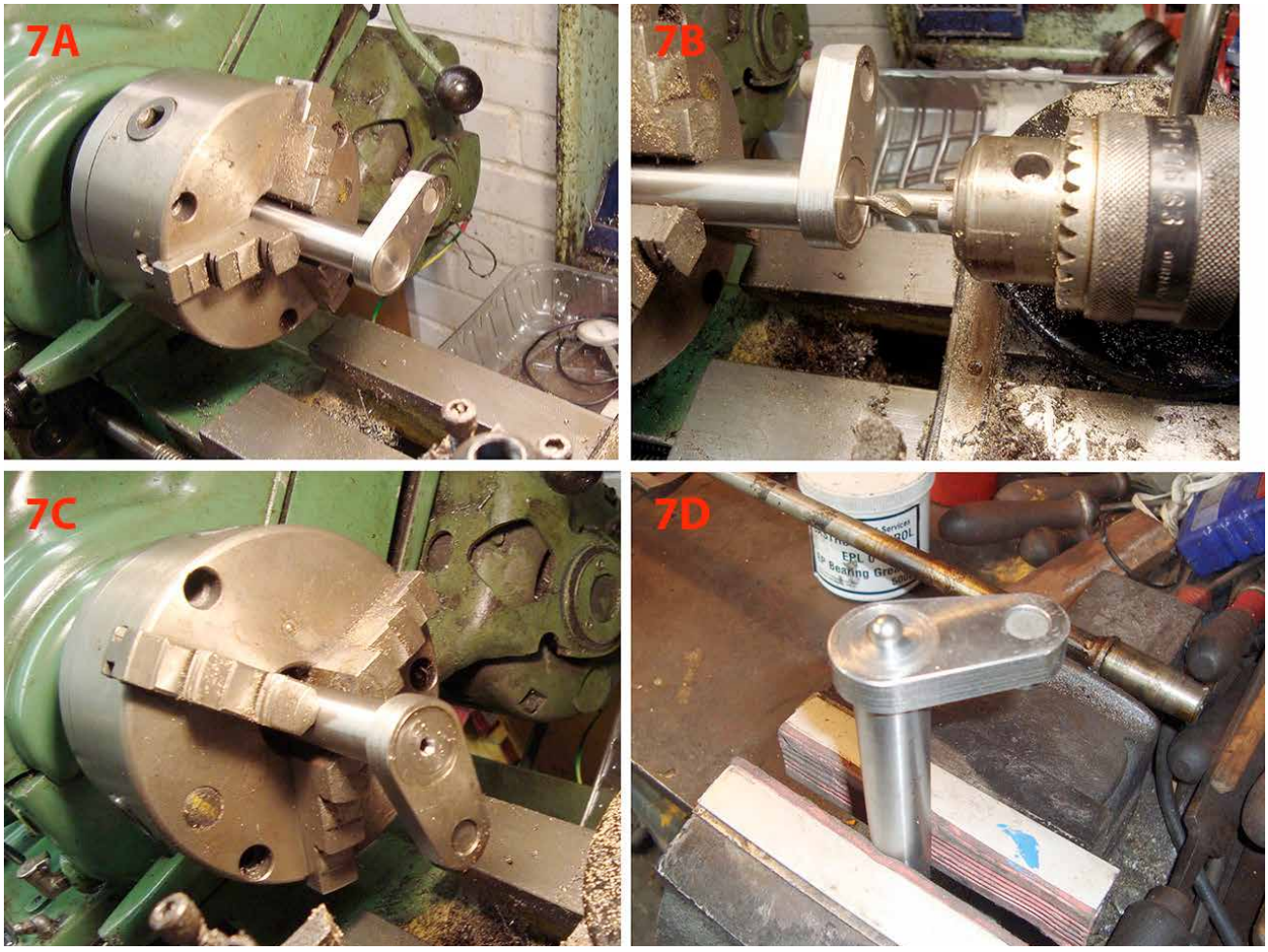
Sector shaft set-up and modification:

Picture 6: Shows the removal of the sector shaft once more, and the worm peg being pressed in using the jaws of a vice—quick and simple.



As I have a Bishop Cam Steering Play Control Adapter it was necessary to find the centre of the sector shaft and drill a small centre hole with a chamfer for centring this upgraded top plate's ball bearing. This was done with a centre drill on a lathe.

Picture 7: Shows the centring and chamfer being done.



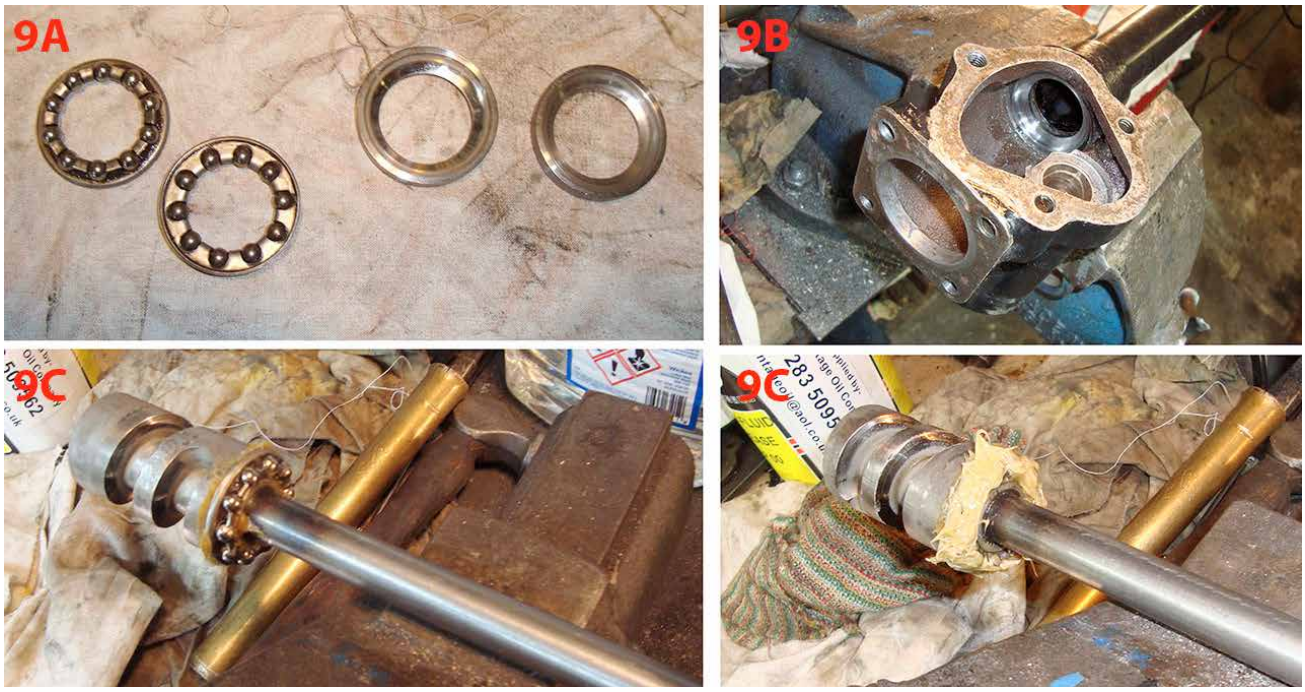
A new centreline was also needed on the other end of the new sector shaft to align with the centreline on the drop arm to ensure the arm is fitted in the correct position. On an engineer's plate, using engineer's blue on the end of the shaft; clamping the shaft in small bench jaws; ensuring by eye it was vertically aligned and using a steel right angle, the centre line was scribed.

Picture 8: Shows these steps and a final permanent marking with a cold chisel.

Fitting bearings and bearing races:

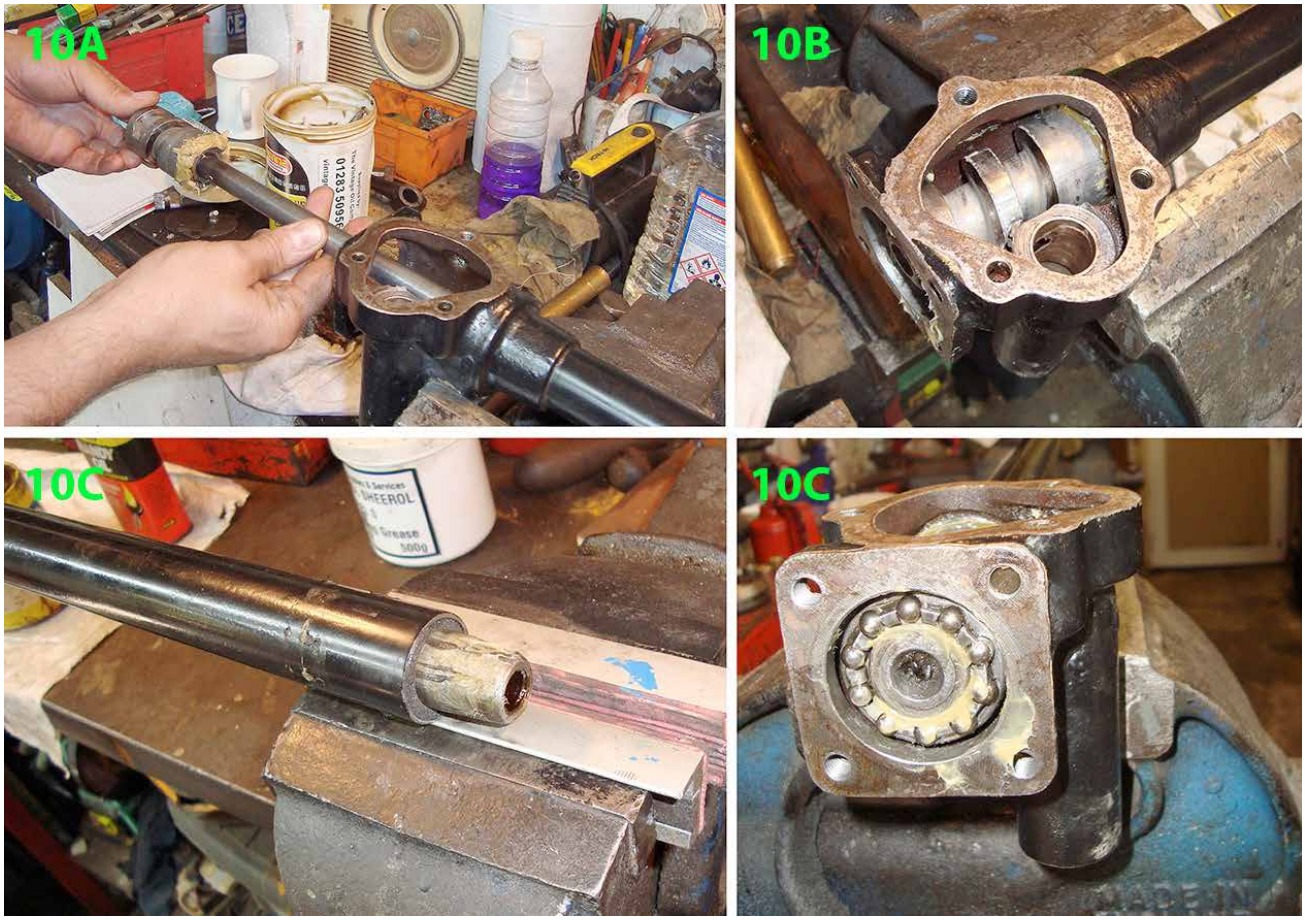
Time to start the refit and fitting new bearings and new bearing races. Following a second thorough cleaning of the box and all components, the first new bearing race was lightly oiled on its outer edge and offered up and fitted with a brass drift, making sure the curved end was facing the correct way, into the inside of the box to take the bearings. The first bearing was lowered down the full length of the inner steering column after greasing its back side, and butted up against the back of the worm; bearings facing away from the worm. The visible face of the bearing was then given a good coating of grease.

Picture 9: Shows the fitting of the inner bearing and bearing race and their greasing.



The inner steering column with worm and top bearing could then be pushed all the way back up the inside of the outer column. I was fortunate that the felt at the top of the outer steering column was in perfect condition so did not need replacing. A small amount of grease on the top of the inner shaft's tapered collar eased centring and pushed straight through the top felt. The bottom bearing was then greased on its back side and pushed into place at the bottom of the now fitted inner column at the bottom of the worm, ensuring the bearing faced outwards and visible through the bottom bearing plate opening.

Picture 10: Shows the above steps.



The bottom bearing was then greased and the bottom bearing race was them fitted with a brass drift, ensuring the curved and chamfered race faced inside against the bearings and its flat side facing outwards, which would sit flat up against the bottom bearing plate once re fitted.

Setting up and adjusting the bearings:

Next was tightening and adjusting the bearings and setting the number of shims correctly, which was time consuming. After fitting the steering wheel at the top of the column, the bottom bearing plate was offered up and all 4 bolts fitted and nipped up in place without any shims. It was tightened evenly until a small amount of drag was felt when turning the inner column with the steering wheel. Once a small amount of drag could be felt, the gap between the bottom plate and the box itself without any shims was measured with a set of feeler gauges. At first measurement I estimated the gap was about 0.028". Adding and removing shims and retrying numerous times ended with 6 shims in place amounting closely to the aforementioned gap; tightened until a comfortable amount of drag could be felt when turning the wheel; and obviously zero movement backwards and forwards down through the bearings (tugging backwards and forwards directly through the column on the steering wheel). Removing the bottom plate, adding and removing different sequences of different thickness shims and refitting the plate took about eight attempts to attain the satisfactory drag. I could feel the bearings moving when turning the inner column, without any feel of them grinding. Too tight and you feel them grind; too loose and you cannot feel the drag, and the inner column had vertical movement through the length of the column.

Picture 11: Shows the above shimming, and double checking each shim with a micrometer.

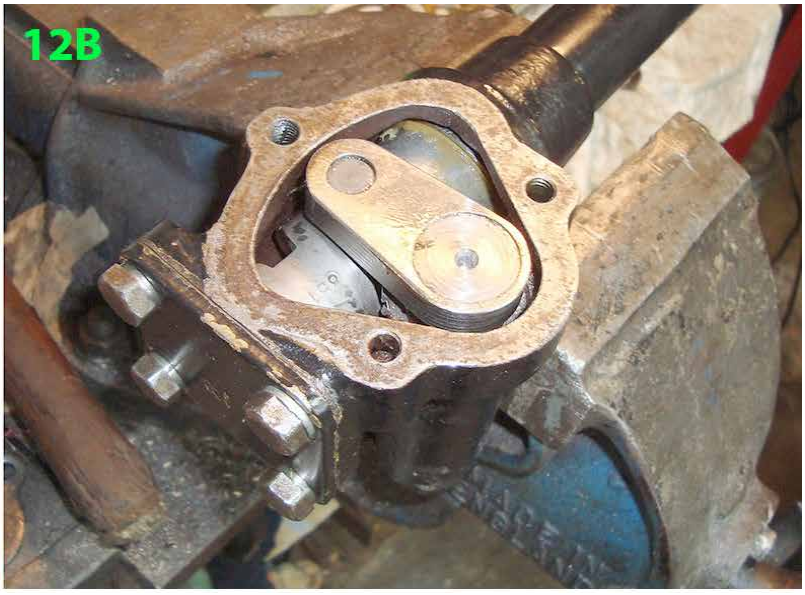
N.B. Keep a notebook to note all the shims' thicknesses and the sequence they are in. This helps when adding and removing and keeping track of the number and their overall thickness; aiding decision-making when adding or removing.

Sector shaft peg into worm - top plate adjustment and setting.

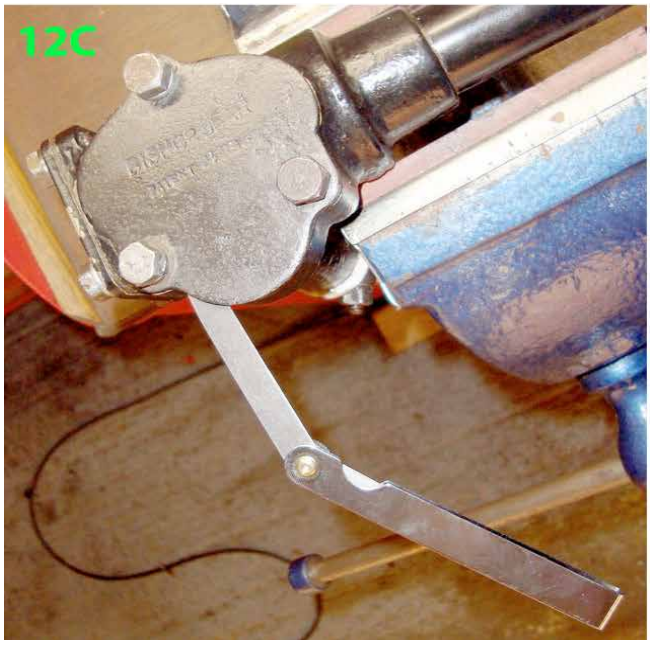
Once the bearings were correctly adjusted and tightened it was time to follow a similar exercise in setting, adjusting, and shimming the top plate for adjustment of the sector shaft peg into the worm. My Bishop Cam Steering Play Control Adaptor needed to be replaced for this exercise with an original top plate to correctly set the number of shims needed.

Thus the next job was greasing the new sector shaft and dropping it into place, ensuring it had full and equal movement left and right and was centred without touching either side of the box at full locks by turning the steering wheel. Following the same procedure as with the bottom bearing end plate, a standard top plate with no shims was lightly and evenly tightened in place till drag could be felt in the steering wheel; specifically a tight spot in the centre of the steering (the straight-ahead position). This tight spot in the centre is as a result of the worm channel being slightly narrower at its centre than at each extreme. The slack at each lock assists the return of the steering to centre once the wheels are fully turned. Again a set of feeler gauges was used to roughly measure the gap between the top plate (no shims fitted) and the box itself. With the new sector shaft in place I estimated the gap was about 0.058"; quite a big gap. Again, with a selection of top plate shims, fitting, removing and refitting the top plate and adding and removing shims till the correct drag was felt. This took many attempts, sometimes with too few, one would lock up the steering with no movement; too many and the centre tight spot was not discernible. Due to the large gap, two temporary shims had to be made from 0.015" metal as I had not purchased sufficient shims for such a large gap.

Picture 12: Fitting of the new sector shaft, - *continued overleaf*



Picture 12: continued - offering up original top plate, and measuring the gap.



Again, keep a notebook and note all the shims' thicknesses used and the sequence they are in. This helps when adding and removing and keeping track of the number and totting up their overall thickness, allowing you to make judgements about which thickness shim to add or remove. Frequently it would be too tight or too loose, so a good selection of different thicknesses allows for a large variation and adjustment. I feel a larger selection of different thickness shims will allow for greater future variation of adjustments with inevitable wear and tear given the large gap in my unit at this time. This exercise was a bit like a maths question on Countdown; however, sadly my instructor was no Rachel Riley to look at! Good job or no learning would have taken place.

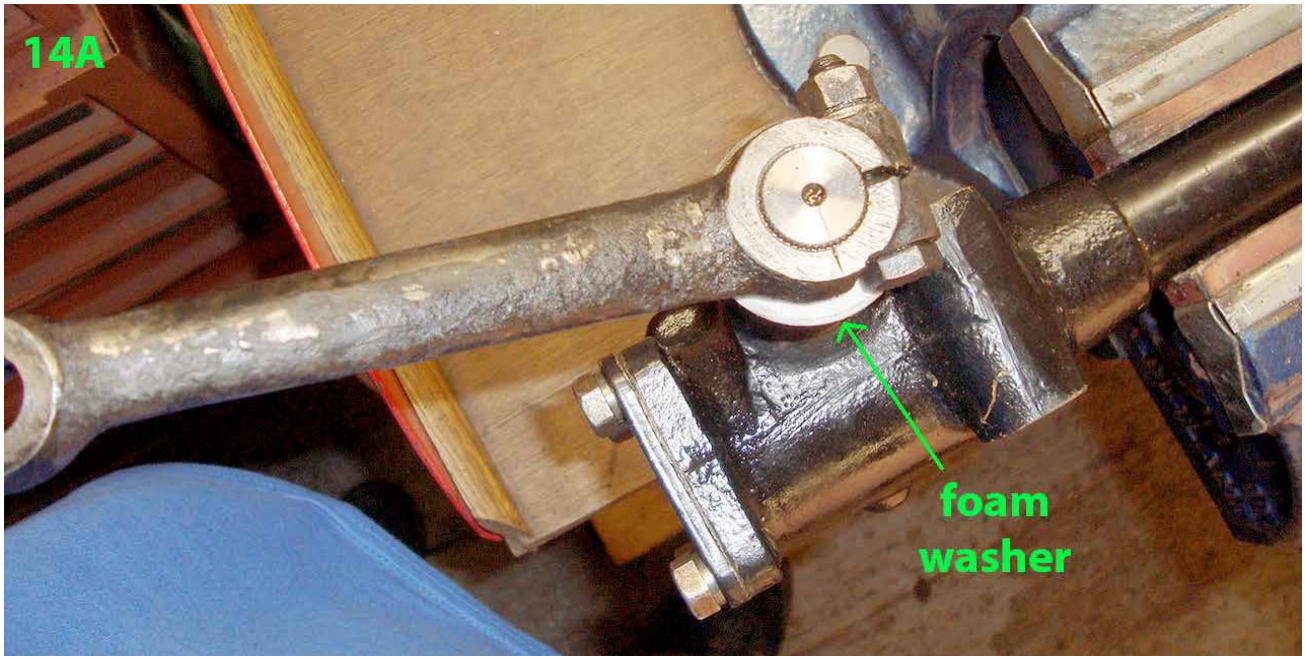
Finally with the shimming concluded I ended with the best part of ten shims giving me a lovely feel through the wheel. All that was left was to fill the box with semi-fluid grease and replace the top plate with the Bishop Cam steering play control adapter I had. I used a freezer bag, filled a corner with a good wad of grease, and piped the majority of the grease into the box. Turning the wheel dragged the grease down into the lower parts of the box quite quickly, allowing further filling to be done. After the box was filled with grease and the upgraded top plate fitted, I worked the steering a dozen or so times through full lock, then removed the plate's upper nut and used the grease nipple to ensure the box was fully filled. Once the grease started coming through the removed top nut hole, the nut was replaced and all three re-tightened.

Picture 13: Final grease filling and adapter fitted.

Fitting the drop arm.

Last of all was to fit the drop arm. Before fitting, I added a small foam washer (taken from the packaging on a stack of recordable CD's) and fitted this over the sector shaft to minimise grease leakage here; I assume originally there may have been a felt washer fitted. The drop arm was then aligned with its marked line to the centre line (added to the sector shaft as mentioned earlier—see pic 8). A snug fit to locate the arm's nut and bolt, but compressing the washer and tapping the nut gently in; and finally firmly tightened up.

Picture 14: Aligning to markings and fitting the drop arm.



Now time to refit the rebuilt column to car…. job done.

Conclusion.

Once fitted, I went out for a test drive. Wow, what a difference; firm, straight, no wandering, lovely firm and positive steering. On a gravelled drive, with only one's index finger and thumb on the edge of the wheel, a quarter-inch movement either side delivered visible wheel movement at the tyres.

Given how frequently I have heard or seen posts about the trouble these boxes give people, and Frankenstein solutions fitting VW parts, this job really is not difficult, once explained (as ever, thank you sincerely Eddie). If I were to give this task a difficulty rating, I would give it a 3 spanner rating out of 10. Obviously modifying for an adapter plate as I have here takes this beyond the average home garage by needing a lathe; but without, and using an original top plate, this really is just a Saturday job. I would do this again any day rather than change brake cylinders all round. This is NOT a fiddly job at all. Getting the column out of the car (7 bolts in total for me) and on the bench was harder than the work on the bench to rebuild.

The shimming is key in getting the required drag on the bearings and worm. Using combinations of different thickness shims to incrementally increase or decrease the thickness between plate and box by the narrowest margins (thousandths of an inch each time) is where this battle is won; hence the need for a note book and some mental arithmetic.

Aware this topic is far larger than just my ramblings above, I hope this is of interest to some, encouragement to have a go, and a helpful reference.