Steering and Suspension

Last updated 20-Dec-2017

If you find the information here useful, you may like to make a small contribution to help offset the costs of providing it. Thank you.

A-arm Inner Bushes

That is, the bushes on the pivot pin bolted to the front cross-member. Originally roadsters had a three-part bush consisting of a steel sleeve and separate rubber bush split into two parts. As the separate bushes can slide around the steel sleeve there is no need for special treatment when fitting them, just bolt up the pivot pin castellated nuts, fit the split pins, jack down, and away you go.

However V8s have a one-piece assembly where the rubber bush is bonded to the steel sleeve to give more positive handling. With these it is important not to tighten the pivot pin castellated nuts until the weight of the car is on its suspension. This is because the outer part of the rubber is a tight fit into the A-arm, the steel sleeve acts as a spacer and is clamped tight by the nut, and so the action of the suspension tends to twist the rubber rather than slide it over the spacer. If the castellated nuts are fully tightened with the suspension hanging down then when the car is on its wheels there is already a lot of twist imparted to the rubber, and when the suspension is compressed over a bump it gets twisted even more. This can tear the rubber to the detriment of handling.

The steel sleeve is quite a snug fit over the pivot pin and can rust to it. In the past I've had to drill through the rubber to part the A-arm from the pivot, then carefully grind through the sleeve before I could chisel it off. The rubber bonds to the A-arm as well requiring more digging-out. Clean up the pivot pin and A-arm hole with a fine file or coarse emery as required to get smooth surfaces. To get the new bush into the A-arm you may well have to smear it with washing-up liquid or Swarfega Original (smooth), then use a vice to press the new bush in. For full seating you may need to use a large socket that will fit over the bush but bear on the A-arm hole on one side, and a small socket that will bear on the sleeve on the other. Smear the pivot pin with copper grease to aid future disassembly and reassemble the A-arms to pivot pin, washers and castellated nut **leaving the nuts a turn or two loose** as mentioned above. Reassemble the A-arms spring pan, spring, swivel axle as described in Front Spring Removal. Lower the car onto its wheels, and only then tighten the castellated nuts and fit the split-pins.

Anti-roll Bars *Updated May 2016*

Front bar issues
Rear bar issues

Some juggling by the factory as to what size front bar was fitted where and when:

Model	Part No.	Size
CB Roadster (Optional to 108038)	AHH7329	9/16"
CB GT to 315949	AHH7331	5/8"
CB V8	BHH882	5/8"
CB GT 315950 - on	BHH882	5/8"
RB Roadster to 76	None	
RB GT to 76	BHH1217	9/16"
RB V8	BHH1217	9/16"
Roadster & GT 77 on	BHH882	5/8"

A rear bar was fitted to both roadster and GT for the 77 model year on, size unknown.

The PO fitted one of the Ron Hopkinson handling kits to the V8 in the shape of the rear bar with telescopic dampers and the uprated front bar. Apparently one has to uprate the front when fitting a rear or it induces oversteer. The front bar is 7/8", I've not measured the rear. However when the factory fitted a rear bar for 77 and later models the front bar was only increased to 5/8". For some time I couldn't really tell whether it was making much of a difference (although the PO said it did, but he would, wouldn't he?) although the back did feel 'different' to my roadster. But whether that was just because I was comparing a CB roadster with an RB V8 I couldn't really say. Then I drove a friends unmodified CB V8 and I could immediately tell it was the same as my roadster i.e. with more movement at the rear as if the rear axle were moving around or the tyres were squirming. But I still didn't know how much of the difference was down to the ARB and how much to the dampers.

April 2007:

I've had a request from someone who has obtained the RH kit but without instructions and asking for any help I can give on where and how the rear bar mounts. Mine were fitted by the PO so I have no instructions, but I can at least supply some photos and a brief description, click on the thumbnail.

February 2016: Gordon Lewis has kindly supplied me with a scan of the original Ron Hopkinson instructions for front and rear, as he has the same set-up as me.

Front bar issues:
One day in the V8 I noticed a grinding on full lock and it turned out to be the rim of the wheel rubbing on the bar. Checked the other lock and it had plenty of clearance, so I gave an exploratory tap on the bar with a lump hammer and it moved sideways a little bit. So I tapped it some more until the clearances were about equal both sides. Now the standard bar on both the V8 and 4-cylinders cars have clamps which sit just inside the pivots and bushes which bolt up to the front apron and so prevent the bar moving from side to side, but mine doesn't have any. Either the PO never fitted them or the Ron Hopkinson kit never provided them. However this is the first time in 9 years and 65k miles so perhaps I do them an injustice. The right-hand (where the rubbing was) front damper has also started leaking recently and although it still seems to be damping normally maybe that has had an effect too. We shall see and if it rubs again **after** I have changed the damper I will have to investigate some clamps.

Summer 2006: Still grinding, and by this time Colin Parkinson had emailed me to use a 1" length of hose of the appropriate diameter split up one side, and a worm clip clamped round that. Didn't have any suitable hose, but I did have an old inner tube I had already cut into, so I

used a 6" (or so) length of 1" width of that, wrapped round the bar several times, and then clamped. We shall see.

Summer 2007: No further grinding, so it looks like a successful mod.

October 2016: Still no grinding, and although I've just been made aware that Brown & Gammons do clamps for 3/4" bars (and other sizes) at £20 a pair ... strips of rubber/split hose and Jubilee clips appeal to me much more!

May 2014: MOT advisory on slight play in the V8 front anti-rollbar bushes. Checked the lower joint to the A-arms first but that was fine, then tried the joint between the drop-link and the bar proper and found several millimetres! Took it apart to find virtually no bush left, just a couple of slivers of rubber on the tube and socket. As an after-market bar long out of manufacture I'm not going to be able to get spares, but maybe the bush for the standard bar might fit. Email one of the usual suspects but of course no response. In the meantime I thought it was worth experimenting with one side. Found a bit of hose that is a reasonable fit for both the sleeve and socket, and with a bit of Vaseline, a suitable bolt and washers, can squeeze the three together enough to get the U-fitting at the top of the drop-link over the new bush and insert the bolt. So easy I decided to do the other side as well, and several hundred miles later there is still no play in either.

October 2016 Subsequently I see these bushes from Brown & Gammons. As the drop-link is the same for the standard and uprated bar, I'm assuming the bolt and hence the ID if the bush is also the same. An enquiry may elicit a response as to whether the OD is the same.

May 2016:

Driving round the block to warm up the oil prior to Vee's service I suddenly started hearing this intermittent loud rattle on the left that seemed towards the rear, that sounded more structural than something loose in the car. My first thought was loose wheel nuts but they were all OK. While the oil was draining I got under the back, poked and prodded but couldn't see or find anything. However as soon as I got under the front to position the jack in preparation for getting the wheels off, I could see the anti-roll bar drop-link had parted company with the bracket on the end of the bar itself! (Interestingly eighteen months later another noise which appeared to be coming from the rear turned out to be a loose front damper). It's going to have to be removed in any event, and I feared the tapered pin would be seized in the A-arm and spring pan as I had experienced before. However that was when I had changed Vee's A-arms because the trunnion holes were ovalled, and as normal I had reassembled with copper-grease so the pin came out with just a tap from a hammer. From the way the link bar had torn away from the bracket and left a shaped hole it was quite easy to see how the two parts had fitted together, so I angle-ground the end of the bar and both faces of the bracket ready for welding.

I was pondering how best to clamp the two together for welding, but as the alignment of the bar and the bracket is angled, I decided to refit the parts temporarily and tack-weld them in-situ. If the angle was out by even a small amount there would be a constant twisting force on the bush around the pin, as well as the bush in the arm. I placed some pieces of hardboard around the joint to protect surrounding areas from weld splatter, levered the bracket down onto the bar, and applied a couple of welds. They seemed secure to I removed the drop-link and finished the welding and clean-up in the vice, and reinstalled it. While working on this I had noticed that the bush I had replaced in May 2014 showed no signs of wear, so that had been a successful repair.

Would my weld repair hold? If it broke again I would need to replace the drop-link. Initially I thought that as a Ron Hopkinson part spares went NLA years ago, which may mean retro-fitting a standard bar, which would mean removal of the rear bar. But while writing this I realised I had been sent a copy of the instructions, which state that the original drop-links are retained, and so are standard items which does make sense.

June 2016: It did break again, partly down to my welding I suppose, the fact that my welder is more applicable to panels, and the RH front bar is thicker than standard so puts more stress on the drop-links. Ordered Sunday morning it arrived Tuesday morning and only took half an hour to fit, and at £10 didn't break the bank.

October 2017: Checking the near-side damper bolts for tightness (found the off-side were loose and causing a clonk) I found the drop-link broken again! Only 15 months old, but for 12 of those Vee was off the road in restoration, it has only done 1000 miles, 500 of which were some longish trips on good roads. Looked up my records to see it was supplied by Moss, who on their description page today say they are made by the original manufacturer, pull-tested to 3/4 ton.

It's interesting to note that the broken end shows the same minimal weld across barely half the diameter of the end of the bar, with no external signs of welding, so quite possibly a type of spot-weld where the two parts are held together and a very large current passed through the joint, rather than with an arc and adding metal with rod or wire.

I started looking at replacements again, and find the price varies from less than £7 at Leacy and more than £15 at B&G, so a 100% (from the cheaper item) range. Some of them looked like they may have some weld where the bar joins the bracket, so starting with Leacy I asked them if they could have a look at one of theirs. Always very obliging they did, and after a pause he said "There's no sign of a weld at all!". Even more obliging he said that there might be more than one manufacturer, and would ring round the other suppliers to see what he could find.

In the meantime I contacted Moss and explained the situation, when I bought it and the use it has had etc. Although I couldn't find the invoice I do have a record of the date so gave that, and next day I get an apology saying they will send me a replacement. (Better service than B&G who supplied an incorrect release bearing for the V8 but despite it being unused refused to do anything about it having had it more than 12 months). On arrival that seems to be the same i.e. no signs of weld around the join.

I have repaired my original again, this time taking more care over the welding. However now I have the FOC replacement I'm going to see about getting it seam-welded where the rod butts up against the bottom of the bracket, so will have what should be a stronger replacement when my repair fails again.

Why so sure it will fail again? Where I live it is impossible to drive anywhere without going over a series of traffic-calming measures. The full-width tarmac ones are bad enough, but there are a number of the fantastically inappropriately named 'pillows', anywhere between one and five depending where I'm going. These are large rectangular slabs of concrete, one in the middle of each lane, with all four sides sloping straight up to a sharp edge before the flat top. If nothing is coming the other way then I can drive between the pillows, and reduce the effect by half as with the relatively narrow track the wheels are only part-way up the sloping sides, and both wheels go up and down about the same amount. But if there is someone coming the other way I can't do that. Neither can I go straight over the top as the exhaust catches the sharp edge around the flat top in both the MGBs. What makes it worse is that even the entry edge of these stands proud of the tarmac - either the tarmac has sunk a bit or they were never

installed low enough in the first place - which makes the problem even worse. So other than waiting until the coast is clear and driving up the middle (and annoying following vehicles), I've been driving with the near-side wheel in the gutter, which means the exhaust clears it. However that tends to push the off-side wheel up and the near-side wheel down, as the rear wheels are still level, which puts the off-side drop-link in compression and the near-side in tension ... i.e. tending to pull it apart! Added to that the PO fitted a Ron Hopkinson rear bar, which apparently necessitates an uprated front bar. So with the uprated front bar there is even more tension on the near-side drop-link, as the bar needs more force to twist it by the same amount. Whilst I can comfortably drive over most of the tarmac full-width strips at nearly 20mph (most of them are in a 20mph zone because of schools) with these pillows especially when I can't drive between them I'm having to creep over them at less than walking-pace, so it's hardly me 'abusing' my suspension. What's really annoying is that some drivers can race over these well in excess of 30mph (20mph zone remember) with impunity, and I've had people overtaking me when I have to slow right down. I complained to the local Council about one of the tarmac strips in the past, as for some reason the rising and falling ramps were only half as long as any of the others, which made them twice as severe and steeper than the guidelines state. They did correct that, so I shall have a go at them about these pillows.

The other possibility is to replace the uprated front bar with an original, which in theory means I would have to remove the rear bar, although when the factory fitted a rear bar they only uprated the front bar from 9/16" to 5/8". However all three times it has broken, effectively meaning no front ARB at all, the only thing I have been aware of on one of the occasions was a noise from the end of the bar hitting the bracket! The other times nothing at all. So for my driving style at least, hardly essential. The original RB V8 item was 9/16" and common to 4-cylinder RB cars, and although it is NLA there might be a possibility of getting a used one.

November 2017:

Scanning eBay I find a 5/8" BHH882 bar for sale at £24.95 + £9.95 P&P so go for it. 1/16" thicker than the original RB V8 bar, but these were used on CB V8s, and a full 1/4" less than the existing one. I wonder about the bushes, and there is an ad on the same page for a pair at £5.10 + £1.95 P&P which didn't seem too bad. But when I started looking at the usual suspects they are £1.20 each plus P&P, and I'll see what they are like first (good). No clamps (to stop the bar moving from side to side) shown, and they (21H667 and 668) are NLA (although the 9/16" ones AHH6546 are available). The RH bar never had them but the bodge worked, so I shall just re-bodge the replacement bar. I do wonder whether 1/32" can be shaved off each of the smaller ones though ... I'll also need new mounting bushes, but they also seem to be available - AHH6541 9/16", 1B4526 5/8", and AHH7927 3/4", all of which use the same clamp. Those three **do** use the same angular clamp, but I had forgotten the RH uses a half-moon clamp! I'll fit the replacement bar using those, but I suspect they will clamp the rubbers too tightly onto the bar and may well squeak, so will get the correct 'straps' BHH2000 in due course. Being a thinner bar I have some hose that will fit with smaller Jubilee clips to prevent the bar moving from side to side, which is neater than the previous bodge using strips of old inner tube.

Getting underneath I did wonder if I would have enough room to manouvere the bars out and in over the bottom hose i.e. would there be enough room below the car and to the side, but there was plenty. Getting the new one fitted was a bit of a fiddle. First I couldn't get the bolt through the eye and the repaired drop-link bracket, and had to remove the drop-link to see what was happening. The replacement bar is more bulbous where it sits in the bracket, and was fouling the additional weld going through a hole in the bracket to the end of the bar, filing that down a bit was all that was needed. Next having forgotten the RH pivot brackets are half-moon shaped whereas the original 'straps' are angular, so not a direct fit, I had to use a jack to lift the straps up a bit compressing the rubber to get the bolts started. As the P&P is more than the correct straps, it

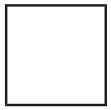
can wait for a supplier visit. Annoying, as I had already had to order new pivot rubbers and pay a high P&P, buying the two lots together would probably not have cost any more.

Rear bar issues:

In 2003 or so I became aware of a rattle from the back of the car. When I checked I found that both of the ARB drop-links had snapped where they connect to the bar itself. When I got them off I could see there was a pin on top of the drop-link that goes through a large dished washer, rubber bush, the eye on the bar, another bush and washer and a Nyloc nut holding it all together. The pin had thinned due to corrosion, eventually snapping, click on the picture at the left to enlarge. They had been on the car some eight years and 65k miles of all weathers but even so I thought it was a bit soon for suspension components to corrode and break. However the rear of the car suddenly felt like an unmodified car again, indicating that the improvement came from the ARB and not the telescopic dampers.

Ron Hopkinson used to be located in Derby but Moss UK in Derby has taken over the distribution. I ordered a pair of drop links and new nuts, together with two bushes and washers which had been lost, one from each side. The rubber bushes being compressible, and with no instructions, I erred on the side of tightness and when fitting the new parts tightened down the nuts quite a bit. I also daubed the parts in Waxoyl to hopefully reduce any subsequent corrosion. Immediately the rear handling was restored and I went merrily on my way. However about 100 miles down the road I had just done a bit of enthusiastic overtaking when I heard a bump, looked in my rear view mirror, and saw something bounding off into the undergrowth. When I checked underneath sure enough the new pin had snapped but this time I had lost both bushes and washers from that side as it had snapped right at the base of the pin and not part way up as before, see the picture on the left.

I got on the phone to Russ at Moss, who asked me to return the broken drop-link, then he sent me a new pin, bushes and washers at no charge saying he wasn't surprised it had broken given the design of the drop-link with its sharp angle. However after the failure of the new drop-link I had a close look at the ARB and realised there is a significant design weakness in the Ron Hopkinson design as a whole and not just the drop-link. If you look at the factory bars where it joins the drop-links you can see there is a joint that allows the drop-link to swivel back and fore freely, and this is important because as the axle goes up and down the angle between the drop-link and the ARB is continually changing. But with the RH arrangement the only movement that can take place is by distorting the upper rubber bushes which themselves are trying to bend the upper pins of the drop-link back and fore. So this time I made what movement there is as easy as possibly by only tightening the nuts enough to fully engage the nylon on the Nyloc nuts. But even sooner this time it seemed, the drop-link on the right-hand side broke yet again, this time while travelling in a straight line but over some undulations.

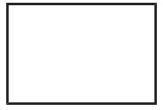


Another phone call to Moss and another free drop-link, bushes and washers, but this time they sent yellow poly bushes instead of black rubber. These are **much** harder than rubber so I would imagine they would break the pins even quicker. Fortunately I had enough rubber bushes left for the top and used the yellow ones on the bottom where there is less bending movement. I decided to try and strengthen the pins by welding and grinding at the base to form a radius instead of a right-angle, you can see the before and after as A and B in the picture on the left. I also cut a chamfer into the base of the bottom washer (C in the picture) so that it sat right at the base of the pin and not up on my weld (D and E before and after). Furthermore I have tried to make the bushes more compliant by shaping the inner hole into a cone rather than the original cylinder, in the hope that this would impart less bending force to the pin. Time will tell, but if one of these breaks again then short of coming up with a completely different joint that allows free pivoting of the drop-link to the bar, I shall have to junk it all.

May 2005: Some 18 months and 4k miles later, and prompted by an enquiry from someone else who has had the same failure, they seem to be holding up, and that includes a reasonable amount of using the power and working the suspension. Someone else reported a while ago that they only just nipped up the nuts and have had no problem, but as mentioned above when I did that on the 2nd replacements they broke even sooner than the 1st replacements. An alternative to doing away with a rear ARB altogether might be to fit the factory system recovered off a scrapped car. The joints at the ends of the bar (which freely articulate) could well be worn and loose but I note they are now available again. Another possibility might be to machine the ends of the RH bar to accept the screw-on factory end joints.

Column/Rack Alignment *Added July 2008*

It is vital to get this correct or you will get rapid wear of the UJ and rack pinion bearing and possible breakage of the pinion shaft. Play in either is a UK MOT failure, but note that a certain amount of rotational play in the collapsible steering columns themselves is acceptable (my Toyota Celica manual quotes 1/4" at the rim, for example, which is about what my V8 has, but I have had to replace the UJ on the roadster a couple of times even though it only had barely detectable play).



The objective is to get the centre-line of the rack shaft crossing the centre-line of the column shaft at the exact centre of the UJ. It is achieved by shims between the four rack to cross-member mounting points, together with positioning of the steering column within the movement of its mounting bolts. It is necessary because the rack and column shafts sit at different angles in both the vertical and horizontal planes, as well as manufacturing tolerances in the bodyshell and crossmember. The factory used this tool (click thumbnail), note that the different bores were probably because it was a standard tool across a range of BL vehicles, although there **are** different lengths of chrome and rubber bumper MGBs of which more later. Highly unlikely to be available now, so how do we replicate it? Personally I wrapped some stiff wire around the end of each shaft, with the tip of each wire at a point in space equal to where the centre of the UJ would be when fitted to that shaft. You can get the tip exactly on the centre line by rotating each shaft in turn, if you get any wobble of the tip it isn't aligned, so tweak it until it is stable. Then it is a matter of fitting shims and adjusting the column as required to get the two tips just touching, which could be quite a long process of trial and error. Others have said they used blobs of Blu-Tak or similar. The problem with both of these is that it is very easy to knock the tip of the wire or Blu-Tak off-centre as well as length. Some have said they loosely fit the rack, connect up the UJ, then measure the gaps between the rack casing and the crossmember and fit shims accordingly. Personally I don't think that is good enough on its own as the weight of the rack will be hanging on the UJ to some extent, although it is probably good enough to get a starting point for shims, and trial and error with pointers after that for fine adjustment. *Update January 2010:* Even worse is a method I've seen where someone turns the steering wheel back and fore while someone else tightens up each rack bolt bit by bit, till the steering wheel binds, then that bolt is slackened a bit, a section snipped out of a washer so it can be slid on the bolt, and that bolt tightened. That is so crude, the UJ will surely start binding way before you can feel any resistance at the steering wheel, hence still be binding when it is backed off a bit and the washer tightened. Besides which the washers that were shown were way thicker than any shim I have seen. Definitely from the "If it isn't bodged it won't work" school of engineering.

Updated January 2011:

Note that the early and intermediate columns (all Mk1 cars, and non-North American chrome bumper cars except V8s) had a different mounting arrangement to the final full energy-absorbing column. The early and intermediate columns have two sets of brackets under the dash which can be used to alter the column position both vertically and horizontally. The later

energy absorbing column has one bracket under the dash with three bolts, and the bottom of the outer tube has a loose plate with three bolts screwing it into the firewall. It's been said that this bottom plate and its bolts are to align the column but that is **not** the case. They simply clamp the loose plate on the bottom of the shaft, via a gasket, to the toe-board and are solely to seal the body aperture against water, noise and fumes ingress. All the alignment must be done by sliding the column on the upper three bolts for in and out adjustment, swivelling it sideways for horizontal adjustment, and by shims between the column and the body bracket, and the rack and the cross-member brackets as required, to get the correct vertical alignment. It's only when alignment is complete you tighten the toe-plate bolts. With all columns if you remove or alter the column even if you haven't altered the rack you will need to recheck the column alignment before tightening the column bolts. Note that for the earlier columns the inner shafts are free to slide up and down and will automatically take up the correct position when the UJ clamp bolts and rack mounting bolts are inserted. This is not the case for the later energy-absorbing column, where its in and out position must be carefully set with the gauges, in order to get the correct spacing of the shaft cut-outs, so that the UJ and rack bolts can be refitted.

As far as using gauges goes my Haynes is completely wrong here, saying as it does that the rack and column should be fitted before installing the alignment gauges. This simply cannot be done, the two have to be moved apart a couple of inches to get the gauges onto the shaft, and off again to refit the UJ. With the gauges on adjust the column position and the shims as above to get the correct alignment. However my Leyland Workshop Manual also has a major error in the section for the later energy absorbing columns, in that it tells you "Slacken the screw on the column point gauge and slide the gauge down until the points of both gauges are on the same plane but not overlapping". The whole point of the gauge screws with this column is that they **must** screw into the cut-outs in the shafts, and the whole column must be slid up and down to get the points to just touch. Unless you do this it is highly likely that you will **not** be able to get the second UJ clamping bolt inserted, or the rack bolts refitted, whichever you do last. This isn't the case with earlier columns, where the whole inner shaft is free to slide up and down inside the outer. With those the shaft will automatically take up the correct position. I repeat, with the later energy-absorbing column you can only adjust the up and down position of the inner, and hence get the cut-out in the correct place for the UJ, by moving the whole column on its upper bolts (which is also why the toe-plate must be able to slide up and down on the column outer). It also tells you to fit the rack after the column, and after the gauges have been fitted. Ok if you have both off, or just the rack, but not if you have only had the column off. It makes more sense to fit the gauges before the column is reinstalled, rather than fit the column, pull the rack, fit the gauges, refit the rack, align, then have to pull and refit the rack again in order to remove the gauges and fit the UJ. Additionally towards the end of the process it tells you to replace the gauges with the UJ, then fully tighten the two upper bolts, then measure the gap at the third bolt, and fit shims accordingly. This makes no sense to me. Better to align, fitting shims as required to the third bolt and fully tightening all three to get the correct alignment while the gauges are still on the shafts. And only then pull the rack forwards to remove the gauges and fit the UJ, and refit the rack. Unlike the column, the rack (with its shims) should always go back in the same position. Whereas if you are only fitting shims to the third column bolt and fully tightening that after the UJ is installed, you could be affecting the vertical alignment. This is why it makes more sense to fit the gauges before installing the column, leaving the rack where it is until the very end of the process, only finally pulling the rack forwards to remove the gauges and refit the UJ. Note that if you raise the front wheels off the ground you only have to remove the four rack bolts, leaving the track-rod ends attached to the steering arms. As you pull the rack forwards to allow you to remove the gauges and fit the UJ, the wheels will simply go 'pigeon-toed' i.e. turn in towards each other. However I have found that with the earlier columns where the inner will slide up and down relative to the outer, it is possible to withdraw the inner enough to remove both parts of the gauge, which means you don't have to disturb the

rack. As mentioned above it is the position of the rack and the fitting of the UJ that determines the final position of the column inner relative to everything else.

Some time later I came across a web page by Simon Jansen in New Zealand who had fabricated his own alignment tool and gave the dimensions he used, see here and scroll down to January 2006. This topic comes up on mail lists and BBs from time to time and I had posted links to Simon's site. Recently someone came back querying the 29mm dimension from the centre of the notch in the shafts and the tip of the tool, saying his was more like 33mm. I passed this on to Simon, and he said it was possible as his car was a mish-mash of components as it was a conversion from rubber bumper to chrome **and** from LHD to RHD. I measured a new RB V8 UJ as carefully as I could and also came up with 33mm, with 45mm for my chrome bumper roadster (measured on car) and posted this as a warning with the link I already had on this site to Simon's page.

Some time after that Kelvin Dodd of Moss US posted this link to a replica tool available from Moss. It's curious that it seems to come with two sets of screws, as it would need two sets of **holes** to be suitable for both chrome and rubber bumper cars, which would need only one set of screws. I asked Kelvin if could confirm whether there were one or two sets of holes, and what the distances to the tips were. He came back with the information expressed slightly differently as being an overall length of 2.11", one hole 0.336" from the **open** end, and another hole 0.936" from the open end. The bore is 0.744+-0.005/0.002" or 18.9mm (slightly smaller than Simon's 19.3mm), and the hole depth is 1.70". Converting this to distance from the tip and millimetres I get 1.174" or 29.82mm for one hole and 1.764" or 44.8mm for the other, and this is where it gets curious. The Moss 29.82mm is pretty close to Simon's 29mm, and the Moss 44.8mm is very close to the 45mm I measured on my CB roadster. However my RB V8 UJ measures 33mm, which is the same measurement that the person who queried Simon's dimension in the first place, and looking in the Parts Catalogue there are only two part numbers for UJs for all models, years and markets i.e. one for CB and one for RB.

So I've re-measured my new RB V8 UJ more carefully, and still get around 1.2415" which equates to 31.5mm, so the Moss 1.174" or 29.82mm remains a mystery (Simon's original 29mm less so as his car is much modified). If making a tool for yourself you will need to check your UJ dimensions very carefully.

Update March 2010: Just been made aware of the identical alignment tool at Moss Europe. The good news is that it is only £7.65 (£16.50 in Sep 2017) as opposed to $24.95 when the exchange rate is 1.5 i.e. $12 or £16! The bad news is that they insist on you ordering at least £10 of parts, before they tell you the shipping costs.

Update August 2010:

I get the Moss gauges with a replacement UJ and track-rod ends, so measure them myself. As I've got to change the steering column UJ, and the rack has to be pulled forward for that, it's a good opportunity to check the alignment at the same time (which is why I bought the gauges with the UJ ...).

The gauges are a nice snug fit on the shafts which is good, and one thumbscrew in each gauge going into the shaft groove holds them firm. The pointers are about 1/8" out, part horizontal and part vertical, which could have contributed to UJ wear, but there is some up and down and side to side play in each shaft so the end result would have been not much by way of sideways forces on the UJ. I'll need to adjust the sideways misalignment at the column mountings, so I opt for seeing if I can get the vertical alignment corrected there as well, rather than fiddling with shims at the rack. This style of collapsible (not energy-absorbing, that

came later, the two halves of collapsible columns slide freely once the plastic peg has broken from an impact. With energy absorbing columns the outer concertinas to absorb energy, as well as the inner collapsing) column used on UK 72 and 73 models is supported by two body brackets, one up by the dash and another one further down under the shelf. Both are slotted so each mounting can move up or down independently giving quite a large change in vertical position of the UJ end of the column shaft. I find the top can go up just a little bit and the bottom down, which puts the gauge pointers in perfect vertical alignment. For horizontal alignment I put a washer between the body bracket and the column bracket on just one side, and this brings the two gauge points together. I was lucky, it really was as simple as that, the first repositioning of the brackets was right, and the first washer I tried was right. Then it's unbolt the rack again and pull it forwards as before to remove the gauges and fit the UJ, lining up the splines by eyeballing the front and rear tyres to get an equal overlap both sides, then fitting the UJ with the wheel in the straight-ahead position, and finally bolt the rack back down. The UJ only attaches to the column shaft in one position as the cut-out for the clamp bolt is cut straight across, but the rack shaft is cut all the way round (oddly the V8 only has notches in **both** shafts). Really I should have put a paint-mark on the rack-shaft in line with the slot in the clamp before removal, but as I've got to change the track-rod ends as well and then get the alignment checked, it'll come straight in the end.

Column Universal Joint *Added August 2010*

Note that chrome bumper UJ consists of separate yokes, spider and bearings (needles in a cup) and the spider and bearings can be replaced using the existing yokes. For rubber bumper cars the overall UJ is smaller which precludes component replacement and it has to be replaced as a complete assembly. It don't know if it applies to all rubber bumper cars, or just to V8s, but there is an oddity in the splined shafts that go in the UJ. On the roadster one shaft has a notch for the clamp bolt meaning it can only go in the UJ one way, and the other shaft has a groove all the way round meaning it can go in the UJ in any rotational position. This means the two shafts can be assembled in as many different relative positions as there are splines as on the roadster. However on the V8 both column and rack shafts only have the notch, which means the two shafts can only ever be in one relative orientation.

Bee had advisories on both track-rod ends this year. Having a quick look the boots had split on both, and the pin on one was loose in the body so I'm surprised it wasn't a fail. But while checking those I became aware of slop in the column UJ (again!) and that is usually a fail. This will be the fourth replacement, the first failing at the next MOT as the cups were loose in the yokes, but I got a 50% refund on those. The second replacement lasted about eight years, this one six, but only at about 2-3k miles per year for each so pretty poor. Thinking it could be column and rack alignment, my previous attempts being done with wire pointers as above, and having recently found Moss UK have the alignment gauges, I get the UJ, track-rod ends and gauges from Moss.

The UJ change was a fairly straightforward operation - remove the four rack bolts, pull it forwards about an inch or so and that with the column shaft pulled back (early collapsible column inners move in and out a couple of inches) gives enough room to get the UJ assembly off the shafts. Circlips removed and tapping the yokes knocks the cups out, but the new ones need the big vice to press them in, so no problems of them being loose next year! I then go to grease it using the supplied nipple and find it is smaller than standard, so my grease gun doesn't fit. The tapping in the UJ body is also smaller than normal so a standard nipple won't fit that either. Email to Moss, but I'm still waiting to hear what size it is or what size grease gun nozzle is required. Two local car spares places don't have any nipples or adapters, and the garage staff at one of them aren't aware of these under-sized nipples, so that problem goes on the back-burner for a while, and I get on with checking the alignment of the column and rack shafts.

That gives me time to ponder the issue of the grease nipple. The supplied nipple is an angled one, and is in two parts i.e. a straight nipple screwing into an angled base. With the steering turned to the appropriate position the nipple is pointing straight up, so easy to get a 6mm socket on to unscrew it from its base, which I had previously screwed in to the tapered threads so as to position the nipple between the two yokes. I have the idea of making an adapter by finding a bolt that screws into the nipple base, drilling a hole through that, cutting the head off, then drilling and tapping a straight standard nipple to screw on to the bolt. The first brass bolt I find in my box of bits screws into the nipple base. It's a bit loose as the threads aren't the same but should be OK as I only intend to use it for greasing, replacing it with the under-sized nipple between services. The bolt has a 3BA thread, so I drill and tap the standard-sized nipple right the way through (it doesn't need the ball and spring to keep dirt out as it isn't staying on the car) making it easier to clear out swarf afterwards, and I pump a little grease through the assembled nipple and adapter stud just to make sure they are clean. Unscrew the under-sized nipple, screw in my adapter, pump grease gently until some issues from the cups, and none comes from where the adapter screws into the nipple base, which I reckon is a pretty good result! Finally unscrew the adapter and refit the under-sized nipple (which still has its ball and spring to keep dirt out of course). All I have to do now it put the adapter in a small poly bag and keep it somewhere I can find it at the next service ...

Dimensions

	Front Track	Rear Track	Wheelbase
Wire wheels	4' 1 1/4"	4' 1 1/4"	7' 7"
Steel wheels	4' 1"	4' 1 1/4"	7' 7"

Front Hub Grease Caps

Stud wheel *November 2016*
Centre-Lock wheel *January 2010*

Stud wheel grease caps:

An interference-fit in the hub they can be pretty tight. A sharp-edged drift is needed to get between the flange on the cup and the outer face of the hub to start prising them out, working first one side then the other. The flange means that the cup only goes into the hub about 1/4". Relatively easy to tap back on with a light hammer. My Workshop Manual shows what looks more like a spring-clip, which could be intended to cover a hole through which grease is injected, or to retain a loose cup which isn't shown. However it is described as a cup, and is shown as that in the Parts Catalogue, and is a cup in practice. One person has said his cups are held in with spring clips, but didn't explain further.

Centre-lock grease caps

Like the stud-wheel type they can be pretty tight. Unlike the stud-wheel type they are recessed inside the splined part of the hub so less (if any at all) opportunity for prising them out. But there is a threaded stud on the end of the cap which aids removal and refitting. They are a clearance fit down the inside of the splined tube, no flange which would mean the ID of the splined tube would have to be even bigger (which would either reduce the thickness of the wall of the splined tube or mean it would have a larger OD which would impact on the dimensions of the wheel hub). Without the flange they bottom against a shoulder inside the hub, and are inserted about 1/2" before this happens. At a pinch the threaded stud could be gripped by a pair of

pliers and pulled and wiggled to get the cap out, but that damages the threads so a more elegant solution is called for.

The stud thread is 1/4" UNF, so a nut welded onto the end of a tube or bar, with some means of levering it out once it is screwed in will do the trick. I thought about a couple of lengths of bar pivoted together, but I've got enough volume and weight of tools as it is. So I opted for a length of tubing about 4" long, with a nut welded to one end. A slot drilled in one side to insert the blade of a largish screwdriver, and away we go.

Screw the tube on to the stud until the slot is just about level with the end of the hub, insert screwdriver, and lever. If the slot is too deep in the hub the angle of the screwdriver will tend to try and push the cap to one side rather than levering it off, ditto if the slot isn't in far enough, close to a right -angle will be fine. The cap is pushed in about 3/4" or more so once the cap has started to move you will probably need to remove the screwdriver, screw the tube onto the stud a few more turns, then lever again. For replacement you can either leave the tube on the stud and tap the open end of the tube, or any one of a number of other methods. There is a distinct change in sound from a dull 'thock' to a sharp 'clink' when the cap is fully on.

November 2016: A fora contributor reports that his new grease caps were way too small, thinking they had to be hammered to expand into the hub (like the disc-type engine block core plugs). They don't - early ones may have been fairly loose fitting with a spring to retain them, but the Parts Catalogue and all those I've seen at suppliers and found via Google images are plain and are a light interference fit in the hub. Although my splined tubes have an ID of about 1.87", and grease caps have an OD of 1.845" to 1.85" (being simply pressed sheet they are not precision) the poster's splined tube was more like 2" ID i.e. non-standard. He's found some 50mm trailer grease caps, but they don't have the threaded stud on the end so even if he can get them in he may not get them out again! Neither do they have the flange, which means if he can get them down the splined tubes he stands a chance of getting them in the hub. It also begs the question of what the OD of his splined tube is, and hence the ID of the splined hub of the wheel. If they are standard then the walls of his splined tubes are significantly thinner than standard, with all that implies. If they are larger then he must have non-standard wheels as well.

Front Wheel Bearings

End-float
Replacement

Front Bearing End-float

The socket for the front hub nuts (on my 73 roadster and 75 factory V8) is 1 1/8" AF. If you have wire wheels you will need a method of removing the grease-caps.

Why end-float?
How do I set end-float?

Why end-float? *Updated August 2011*
The Factory Manual is quite clear on the need for a particular end-float i.e. 'free play' of 0.002 to 0.004 thou to be present with the type of taper roller bearings used in the MGB. Anyone who tells you to apply a pre-load of 11-15lb ft (i.e. the opposite of end-float) or whatever is wrong. That may be correct for other applications, but not for the MGB. Some say that you don't need shims in the front hubs, some even say you don't even need the spacer. Others say that the act of clamping the inner races, shims and spacer between the hub nut and the base of the axle spindle significantly increases its strength.

I can certainly imagine that without shims or spacer the inner race could spin on the axle wrecking it, so personally I prefer to keep things as they came out of the factory.

As to why it's needed, consider the following: The brake disc gets very hot, that is attached to the hub, and when that gets hot it expands along the line of the stub-axle as well as radially, and this longitudinal expansion moves the outer running surfaces of the two bearings further apart. The stub axle should always be cooler than the hub, so won't expand as much, so the inner running surfaces of the two bearings aren't moved apart as much as the outers. If you look at a cross-section of the hub assembly you will see that the outer running surfaces are effectively between the inner running surfaces, and with the differential expansion each outer will be pushed closer to its inner, reducing the gap for the roller. With no running clearance when cold (let alone if there is 'pre-load'), despite the fact that tapered roller bearings are good at taking axial load as well as radial, this will squeeze the roller between the two running surfaces pushing grease out of the bearing and generating significant heat in the bearing itself, both of which will eventually result in premature failure of the bearing. With the correct end-float set when cold, differential expansion will be taken up by the end-float, so protecting the grease film and bearing surfaces.

How do I set end-float? *Updated May 2015*
It is advisable to have a selection of spare shims to hand before starting the job. There is a base 0.030" (BTB656) then for fine adjustment there are three sizes - .003" (ATB4240), .005" (ATB4241) and .010" (ATB4242). 50 to 55 thou total thickness seems to be the norm, and in the absence of a dial gauge additional shims will be required as below.

- When replacing bearings assemble everything dry first (i.e. without grease) as it keeps things cleaner and is easier to set the end-float. However the oil seal traps the rollers of the inner bearing, so leave this out until the end-float has been set, and the rollers greased, and fitted. This allows the hub to be repeatedly fitted and removed while juggling shims, leaving the inner bearing and spacer on the stub axle, which makes removing and fitting shims much easier, especially on wire-wheel axles.
- The order of parts on the axle is: oil seal collar - inner race of inner bearing - spacer - shims - inner race of outer bearing - bearing retaining washer - nut. Note that the oil seal collar is 'handed' in that there is a chamfer on one inner edge that must go up against the shoulder on the stub-axle.
- The first time you assemble the parts onto the hub leave out the shims and tighten the nut until the bearings bind to fully seat the outer races in the hub.
- Now fit the shims between the spacer and the outer bearing. The objective is to add and subtract combinations of the three thinner shims with the base 0.030" shim until you get an end-float of .002 to .004. Using combinations and multiples of these thinner shims together with the base shim will give from 45 to 60 thou in 0.001" increments as follows:

Additional shims	Qty. of .003 ATB4240	Qty. of .005 ATB4241	Qty of .010 ATB4242
0.015	0	1	1
0.016	2	0	1
0.017	4	1	0
0.018	1	1	1
0.019	3	0	1
0.020	0	0	2

You will see from this that as well as the base 0.030" shim you will need 4 of the 0.003", and 2 each of the 0.005" and 0.010" to make up any combination from 45 to 60 thou. There will almost certainly be some shims in the hub already, but if you make sure you have these as spares before you start you should be fine.

0.021	2	1	1
0.022	4	0	1
0.023	1	0	2
0.024	3	1	1
0.025	0	1	2
0.026	2	0	2
0.027	4	1	1
0.028	1	1	2
0.029	3	0	2
0.030	0	2	2

- Keep juggling shims until you get two combinations that are only 0.001" apart where the thinner combination gives no end-float and the thicker gives just perceptible end-float. Fit the retaining washer and nut and tighten to 40 ft lb plus the next split-pin hole with the thicker set and check end-float is still just perceptible. If so use the thinner of the two sets i.e. the one that gave no play, add another 0.003" shim, and that should give you the required 0.002" to 0.004" end float.
- If tightening has removed all end-float further juggle shims increasing the thickness by 0.001" at a time until you do have just perceptible play with the nut tightened. Then reduce by 0.001", add a 0.003" and again that should give you the required 0.002" to 0.004" end float.
- When you have determined the correct shims remove the races and inject or press grease **in one side only!** This Moss page shows how to do this by pressing the roller cage against a blob of grease in the palm (they say heel) of your hand. Keep going till the grease comes out the other side, and leave a bulge of grease on both sides. **Don't** be tempted to save time by greasing from both sides or you will trap air in the middle of the bearing and possibly cause premature failure. Note that if existing bearings have been removed, washed in petrol or paraffin for inspection, and are being reused, they must be soaked in mineral oil before regreasing. New bearings should already be coated in oil.
- Fill the groove in the oil seal with grease prior to fitting, and the cavity between the oil seal and the inner bearing. Smear the spacer with grease. Don't fill the cavity between the bearings or the grease retaining cap with grease.
  Update October 2008:
  
  There doesn't seem to be any written description of which way round the oil seal goes in the hub in either the Workshop Manual or Haynes, and whilst Porter does cover it in some editions of his 'Purchase and DIY Restoration of the MGB' or 'MGB Restoration Manual' it seems his description differs from his drawing. My 1989 edition of the former doesn't cover it at all, but Neil from the BBS writes that in his 1992 edition Porter on page 179 says the oil seal should be "fitted to the hub with the lip facing inwards or uppermost in this shot"... but 'the shot' shows the seal facing OUTWARDS, which is indeed uppermost in his picture! So he says it right but shows it wrong. The Workshop Manual does have this photo showing the flat side of the seal facing out from the hub and the grooved side i.e. the lip facing inwards. This is probably deliberate to keep water off the spring that provides the tension on the lip, so preventing it rusting, breaking, and consequently letting water and dirt in and grease out. I believe this to be the standard way to do it i.e. the flat side facing the dirt and the lip facing the oil or grease. Certainly for the rear axle half-shaft oil seals both the Workshop Manual and Haynes say "lip facing inwards".

- Reassemble everything, tighten the nut to 40 lb. ft., then tighten further until a hole in the shaft (there should be two at right-angles to one another) lines up with a slot in the nut. This should occur well before the maximum torque of 70 lb. ft. is reached. Some people say that this additional tightening removes the end-float and to fit additional shims on the **outside** of the outer bearing until the hole and slots line up at the minimum torque. Personally I have not found that this loss of end-float occurs. However when trying it I did find that fitting shims between outer bearing and locating washer causes slivers of metal to be shaved off the shims when the nut is tightened, because in this position they are resting on the threads of the axle. Slivers of metal are **not** what you want in your new bearing!

If shimming from scratch i.e. there are none at all in there (as a pal of a pal found) then Brown & Gammons recommend starting with 55 thou, i.e. the base 30 plus two tens and a five, which is close to what I found in the V8 recently.

July 2015: **Front Bearing Replacement** - by Michael Beswick *(with additional comments)*

Half way through our trip to northern Spain, the front hub bearing started to rumble. However stout-hearted car got us home safely: the only concessions being using bigger roads (flatter and less twisty) and driving at 50 mph. (Major change to fuel economy!)

Back home and on the ramp a quick spin of the wheel confirmed it was no better but no worse. The usual suspects all show a bearing kit (inner, outer bearing, oil seal) at about the same price as a single bearing. Being suspicious I wondered about quality. I bought both and was none the wiser- Timken and Toyo were the brand names in the B&G kit.

The car has wire wheels which means that most of the work is carried out down a 4" long tube.....

First off is to remove the brake caliper and tie it up out of the way. Next is removing the grease cap: mine has a threaded stud in the centre so I was able to use a 1 1/4 UNF bolt with a nut just on the end to screw on to the stud. (A second nut acted as a locknut). Out it pulled. Thankfully the split pin was put in a way to make it's unbending and removal easy (see later). Castellated nut size is 1 1/8 AF. Quick tap on the disc edge and the hub pulls free. On a stud-wheel hub the tabbed washer and outer bearing rollers will probably fall out at this point. Note the oil seal collar which will probably remain on the stub axle shaft. (Once when changing a hub I omitted this part-everything wobbled about a bit....)

On the wire-wheel hub the outer bearing rollers and tabbed washer are likely to be rolling about inside the hub "tube": the distance piece inside the hub. Levering the oil seal out allows the inner bearing rollers to be removed and then the distance piece. You now have the hub with only the two outer races (tapered collars) that the rollers run on. These need to be drifted out. There are convenient recesses (two at 180 degrees to each other for each race) that allow a long punch to be used against the larger back face of the races. Once these are out it is worth cleaning the whole internal "tube" out.

Inserting the new races is more difficult with a wire wheel hub because the outer race is down the 4" tube. A 1 5/16" socket fitted nicely on the (narrow) face of the race - an extension allowed it to be driven home - well nearly. The extension had the usual spring loaded ball bearing to ensure it remained in the socket. This allowed a certain amount of play which negated the "bang" of the hammer. It should be possible to compensate for this, but as I have a mate with an independent garage I went there. They had the correct tool which is very similar: a stepped disc in Aluminium with a central hole and a shaft with a shoulder that fitted in the hole in the disc. Then a big hammer and in it went. The race

for the outer bearing is much easier as it is much more accessible, it would need a very large socket so I'd suggest a punch would do it fine - better still if it is ali *(or brass, and I have used the old outer race to spread the 'point' load of the hammer round a significant portion of the edge of the new race, tapping alternately on opposite sides.* ***Be absolutely sure you insert the outer races the correct way round i.e. wider face on the inside. Get this wrong and you probably won't be able to drift it out again as the recesses are not deep enough****)*.

As usually suggested I went for fitting the whole lot "dry" to get the end float correct. This requires the oil seal to be left off *(advisable on wire-wheel hubs as otherwise the shims have to be repeatedly removed and replaced down the tube which is a pain)*. I fitted the inner race, distance piece and the 30 thou shim on to the shaft, and offered up the hub. However you need to be able to hold the hub horizontal with one hand whilst jiggling the outer bearing on to the shaft. A mole wrench clamped loosely (so adjustable) at the top of the disc to the back plate allowed two hands - actually fingers - to insert the bearing. Jiggle the tabbed washer on and tighten to 40 ft lbs + next slot in the castellation nut. It jammed solid..... *(NB: when first fitting the hub with new bearings you leave out the shims and tighten to 40 ft lb to fully seat the outer races of both inner and outer bearings)*.

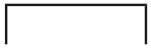
So remove nut, washer, and ease the hub off. The inner bearing, distance piece, shim remained on the shaft, so I added 21 thou - a guess *(Brown & Gammons recommend a starting value of 50-55 i.e. the 30 plus 20-25)* - of shims and repeated the operation. Bingo - just the right amount of 'tonk' as described by John Twist. *(For those not familiar with the 'tonk' unit of end-float measurement see this setting procedure.)* I have used a dial gauge but frankly it was more bother than it was worth.

Undo the lot and grease the bearings in the prescribed manner. I read a Moss Motors document but found I got as much in the hole for the shaft as I did in the race itself. A finger worked as well. Next fit the oil seal having first put in the distance piece. Then it all got a bit more difficult *(with the wire-wheel hub, a stud-wheel hub is much easier)*. Without the oil seal and with the inner bearing on the shaft the shims could be added easily: once the oil seal is in place and the distance piece is flopping about in the "gap", the shims have to be added after the hub has been fitted to the axle shaft *(i.e. down the 4" tube)*, hence the need for the mole wrench to keep it square. I tried all manner of ways to trickle the shims on to the shaft but they get caught on the threads or the shoulder. Eventually I decided to use grease as stiction and fit them to the bearing. I was able to use my finger to line up the bearing square on the and of the shaft and tickle it in. Fitted the tabbed washer and nut....and it jammed solid.

By now there was grease in the system and I had fitted the oil seal so I just kept going (4 attempts) till I got it right. On my axle shaft there was only a single hole for the split pin - not a second at right angles, so I had to use the top end of the torque range to get it to line up. When inserting the split pin do so in a way that the longer leg is facing towards you, and then PULL it a little towards you. It is much easier to push it straight for later removal than trying to get a hook round the back!

So how would I do it next time? Broadly the same: theoretically grease should not compromise the end float, so I am blaming fitter error. However once the oil seal has been fitted trapping the distance piece, fitting shims becomes much more difficult, so I would still use the stiction method-after all grease in there by then.

Front Bump/rebound rubbers *Added September 2010*



Spotted the bump rubber on the left side was missing from the bracket while working on Vee's king-pins. Got a new one but when removing the old one of course the alloy spacer crumbled quite badly, it was only then I remembered it happening the last time I changed one! It rots really badly - swelling so much it distorts the bracket and even the cross-member mounting point, and because the bolts seize in the spacer the ends around the holes tend to break away. It may also be the swelling against the face that holds the bump rubber that pushes the rubber out of the bracket. So something else to order, but in the meantime I managed to file the worst of the swelling off so it could be refitted temporarily with the new rubbers. The bolts are a bit of a fiddle, you may be able to get a slim ring-spanner on the nuts which are inside the bracket, failing that you will have to use an open-ended. And if **that** slips off and wrecks the heads they will have to be ground off. Even with a slim ring-spanner you can only undo the nuts part way, as the nuts move up the threads of the bolt they reduce the space available to remove and refit the spanner. Using a socket on the bolt head and using the ratchet on that to turn the bolt, leaving the spanner on the nut helps. It's this that is going to crack the spacer around the bolt, but you are going to have to face that at some point anyway.

When fitting the new bracket and spacer get the long bolts up through the bottom part, the spacer and the cross-member first, and fit the spring washers and nuts. Partially tighten those, and only then tap the bracket with a hammer and/or use a pointed drift to line up the top holes for the short bolts, fit them and their spring-washers and nuts, then fully tighten everything. Daub new spacer and bolts, and the inside of the rubbers bracket, in Waxoyl before fitting!

Front Spring Replacement

Specifications

The first thing to say is that spring compressors are not required. Support the front of the car safely e.g. with axle stands under the chassis rails and/or front crossmember. Place a jack under the spring-pan and raise the axle until the upper wishbone (shock-absorber arms) are clear of both the upper and lower bump and rebound rubbers.

Most seem to agree thus far, but opinions differ as to whether the four bolts that secure the spring-pan to the lower A-arms should be removed next and just the spring-pan lowered to free the spring, or whether the lower trunnion bolt should be removed disconnecting the A-arms from the swivel axle, and the A-arms and spring pan complete lowered to free the spring.

Having tried both ways I would only ever recommend the latter method. There are two reasons for this:

> Firstly, because the spring-pan is not parallel with the ground anyway, and even less so when the front of the car is raised, it is extremely difficult to support it so that the tension is taken off all four bolts at the same time. Instead the pan has to be raised and lowered slightly for each bolt to be removed. This damages the threads on the bolts. Even worse is reassembly - one has to fiddle around raising and lowering the jack little bits at a time to get the four bolts through the A-arms and spring pan one at a time, all the while with one's face just inches from an unsecured spring, don't forget the spring pan is also unsecured and could twist releasing the spring.
>
> Secondly, if there is a front anti-roll bar fitted it is my experience that the drop-link seizes in the A-arm, and the two have to be removed together for them to be parted. If this happens you have no option but to use my preferred method.

Removing the swivel-axle to A-arms bolt (lower fulcrum pivot) allows you to lower the spring pan while it is still held securely until all spring tension is released. With the jack out

of the way you push the pan down a bit more with one hand and simply lift the spring out with the other. That done, you can tackle the spring-pan to A-arm bolts in complete safety.

In the time-honoured phrase - "reassembly is the reverse of removal" - that is, push down the A-arms complete with spring-pan, insert spring, jack spring-pan and pivot swivel-axle until the lower bolt can be inserted. The only thing to watch is that the grease seal, thrust washer and seal support are all present and correct on reassembly.

Another tip when buying new springs of any type is to insist on a pair with the same free height! The pair my supplier put on the counter for Vee differed by nearly 1/4". He got a matched pair without quibble, but said "it won't make any difference". At first I thought he meant that the free height made no difference to the loaded height which is obviously wrong, but once fitted although the loaded height had been the same with the old springs with the new, even after a shakedown run, there was a 1/2" difference. So maybe he meant "it doesn't matter what the free height is, the loaded heights will probably be different anyway!". Also the free heights were quite a bit higher than spec, so if you are able go for the shortest.

Update December 2005: A tip from Michael Beswick is to leave the spring pan to A-arm bolts on one side slack by a turn or two to make insertion of the assembled fulcrum, thrust washers, seals etc. into the A-arms a little easier.

Update September 2007 Another tip is that when sliding the lower fulcrum out of the A-arms, as soon as the hole reappears outside the arms, refit the bolt and nut and this will stop the grease seals etc. falling off and the bolt/nut getting dirty/lost. But I digress. Many moons ago for various reasons I fitted CB GT front springs to the roadster as they are stiffer, but with a lower free height, which gives much the same ride height. At the time they gave much the same ride height with less roll and dive under braking, but since then they have settled and for some time I haven't been able to get the hydraulic jack under the rear edge of the cross-member, and the A-arms and track-rods were both angled upwards (outer ends relative to inner) which didn't seem to me to be correct. So I decided to replace them with new originals, and in doing so found that I needed to employ a combination of the two methods above. The CB GT springs have a free height of 9.32" (and the used ones were a little less than this anyway) and pushing down on the A-arms/spring pan with the lower fulcrum pin removed was all I needed to do to get the old spring out. However the correct springs have a free height of 10.2" (and in fact the new ones were a little taller than that) and I could not push the arms down far enough to get the new spring located in the groove in the spring pan. So I removed the inner spring pan bolts altogether, and with the outer bolts slackened (actually only the bolt as I couldn't get at the anti-roll bar drop-link nut easily) the pan pivoted downwards with a bit of pressure and in went the spring. I then jacked up under the inner edge of the pan, and with a bit more levering got the holes aligned and the bolts back in. This is still a much safer method than complete removal of the four spring pan bolts as the pan and hence the spring is still securely retained by the outer two bolts (or bolt and anti-roll bar drop-link pin). So far so good, but when I jacked up under the spring pan I found I couldn't compress the new springs enough to get the holes in the fulcrum and A-arms aligned, I had to jack under the far outer edge of the pan to be able to do it. Not only that, but when on the ground a quick measurement showed that the front ride height had leapt up from 14" to 16" and looked ridiculous!

Not being a believer in springs 'settling' soon after installation, nevertheless a tour round some of the speed-hump ridden streets of Solihull and some bumpy country lanes for an hour settled them to 15.375" at the front both sides, with 14.125" at the rear also both sides. Better, but still a little high at the front, but it will probably settle more over time. I think the initial settling is due to the front springs only sitting in the spring-pan and cross-member, and so not fully seated until they have been worked up and down a bit. In contrast the rear springs are positively located by bolts and I'd expect very little initial settling. The A-arms and track rods

are now angled slightly downwards (click thumbnail), and I now have 6.625" clearance under the front cross-member as opposed to about 5.5" previously.

Update October 2007

Replaced Vee's front springs today. Being shorter it was much easier than Bee's, I only had to remove the anti-roll bar and lower fulcrum bolts, and slacken the bolts between the spring pan and the rear A-arm. Pushing the pan and A-arms down the old spring came out easy enough, although the axle assembly kept pivoting inwards getting in the way, and I didn't have enough hands to hold that out, push down the spring pan and lift out/replace the spring, so I propped the axle assembly up out of the way with a piece of wood between the hub and the ground. Didn't take much more than an hour each side. Before starting the ride height between hub centre and bottom of the trim strip was 14.5" on the right and 14.625 on the left. Immediately after replacement the right was 16.25" and the left 16.5", and after a couple of miles over the speed bumps came down to 15" and 15.5" More disparity there than originally, and the springs were the same free height, so we'll see how it goes. Clearance under the Y-pipe on the exhaust is now 4.45", up from 3.5" before, which was way below the spec ground clearance of 4.25". This thumbnail shows (from left to right) the original roadster springs (with a nice curve in them!) taken out some years ago, the newly removed CB GT springs, and new V8 springs waiting to go into Vee.

Update October 2009
Measured Bee's ride height as 14.75" right front, 14.625" left front, and 14.25" for both rears. Vee's are 14.5" right front, 14.625" left front, 15.375" right rear, and 15.6875" left rear.

King-pins

Lubrication

I've been becoming increasingly aware of a clonk when applying and releasing the brakes in Vee, even gently, and feeling something through the pedal, although nothing came up on the MOT. Getting the spring pans up on axle stands i.e. wheels off the ground I couldn't find anything loose on the steering arms, track-rod ends, calipers, dampers, A-arms, wheel bearings, trunnions or king-pin bushes except that when I levered the tyre up and down the swivel axle was moving up and down on the king-pin, approaching a millimetre, and accompanied by a clonk. "Ah-ha", I thought, "King-pin thrust washers and shims". However I couldn't and still can't see how this would occur under braking - the weight of the car is already on the thrust washers, braking is only going to add to that, and braking is putting a rotational force on the king-pin bushes and not vertical. Nevertheless as the Workshop Manual quotes .008" to .013" (.20 to .32mm) they need attention.

The Workshop Manual shows three washers but only labels two of them - a thrust washer and a floating thrust washer (shim) .052" to .057" i.e. .055" nominal. The Parts Catalogue also shows three washers, but just as part of a king-pin repair kit and not as separately identified parts. The MGOC site shows the main thrust washer ATC4264 but not the shims, saying the shims are only available as part of a repair kit that includes the king-pin. Googling ATC4264 displayed Quinton-Hazell, Brown & Gammons, MGOC and Moss Europe hits. B&G didn't list any other parts, QH listed shims with the main thrust washer but didn't say what axle it was for, MGOC listed the shims as separately available although only for the MGC, but Moss listed the shims indicating they are suitable for both the B and C! The shims are in three different sizes ATC4261 (.055" nominal), ATC4262 (.060" nominal) and ATC4263 (.065" nominal) which are selected to obtain the required end-float, the main phosphor bronze thrust washer being sandwiched between two of the shims. So off goes my order to Moss for two

sets of washers and shims, as well as the bump/rebound stop which I had noticed had lost its bump rubber on the left-hand side. While placing the order online I noticed a checkbox by each item something to do with back-ordering. It was only afterwards I wondered if some or all of the items were out of stock, which is a possibility for things like the shims, much less so for the bump/rebound stop, I would have thought. But in the event they all arrived two days later.

So up goes the front of the car (cross-member on axle stands) and off comes the right-hand wheel. It seems to me that just undoing the big nut on the end of the king-pin will allow the trunnion to come off and reveal the thrust washers and shims, the pin through the trunnion and damper arms is obviously clear of it. However the rubber bushes around that pin fit into a notch in the king-pin, so really the damper arms need to be disconnected from the trunnion and the bushes removed before the trunnion can be removed from the king-pin. And when doing that you will probably need to slacken the clamping bolt that goes through the damper arms. Jack under the spring-pan so the damper arms just lift off the rebound rubbers to take the tension off the trunnion, damper arms and pin before trying to remove the pin. Having replaced dampers and a swivel axle at various times, if I hadn't had that pin and the bushes out beforehand they were seized solid and I had to cut through the pin both sides before I could part them, removing the damper arms clamp bolt and wedging the arms apart meant you can do this without damaging either arms or trunnion. So if you haven't had yours apart before you might like to lay in a repair kit or two (bushes, pin and nut) beforehand.

Both top link repair kits I have purchased in the past have been supplied with a Nyloc nut instead of the original castellated nut and split-pin, even though the pin does have the split pin hole. **These nuts have been way too deep, so much so that the threads of the pin weren't engaging with the nylon insert and so totally inadequate**. If you use a Nyloc at least three threads of the pin are supposed to be exposed, but I wouldn't even trust that as this one pin is all that is holding the top of the wheel up. Fortunately I had suitable castellated nuts I could use instead, and split-pins. At the time of writing MGOC (item 73) say they are supplying Nylocs with this kit, and Leacy say (and show) they supply castellated, so guess which one gets my order.

Even then the trunnion could be stuck on the king-pin, so with the nut on the king-pin slackened clear of the top of the trunnion but short of the top of the king-pin, lower the jack from under the spring-pan, and tap the end of the king-pin. Mine are rounded at the top so there was no chance of damaging the ends of the threads, and it came free. Before completely removing the nut jack under the spring-pan again to stop the king-pin and trunnion flying apart. Also have a length of cord available so that when it does come off you can tie up the hub e.g. to the bump/rebound bracket or anti-roll bar drop link to stop it hanging on the brake hose.

With the trunnion lifted off the end of the king-pin you can retrieve the thick phosphor bronze thrust washer sandwiched between two thinner steel shims. It's now a case of juggling shims, refitting the trunnion and retightening the king-pin nut and checking play. If you have a castellated nut it makes sense here to drop a spacer over the king-pin before fitting the nut so you only have to tighten it a few turns, instead of winding it on and off an inch or more. It's even more important with a Nyloc nut, or you will have to replace that as well, with the number of times you are likely to have to fit and remove it wearing the nylon insert out. If you can't find a spacer that keeps the nylon insert clear of the threads when the nut is tightened, try and find a plain nut instead. To check end-float with each combination as well as fitting the trunnion to the king-pin I slotted the pin back through the trunnion and the damper arms and fitted the nut a few turns (the damper arms with trunnion can be lifted up far

enough to clear the top of the kin-pin), lowered the jack under the spring-pan so the tension of the spring was pulling the trunnion down, then lifting and lowering the hub and swivel axle reveals the play. It's difficult to measure without a dial gauge, but 0.2 to 0.32mm is pretty easy to judge by eye, easier than 8 to 13 thou! Remember to jack under the spring pan again each time before removing the king-pin nut to try another combination.

And this is where the problems started. The Moss shims came in three bags, two to a bag, with the bags labelled with the three different sizes. The shims were all stamped with a sizing number, and I had two each of three numbers 6 (or 9), 7 and 8 - all so far so good. But when I started juggling shims I wasn't making any difference, which didn't make sense. So I started measuring everything - new washer and shims as well as the old (the old shims had no visible markings) and discovered that my six new shims which were supposed to be two each of three different sizes, were actually five thin shims and one thick! Added to that the new thrust washers were actually **thinner** than the old ones, at 0.179" as opposed to 0.184", and the old shims were 0.054" and 0.064" i.e. one thin and one thick, and apparently unworn! I suppose the thin one could originally have been a thick or middle one, worn down to exactly the thickness of a thin one, but I find that unlikely. Also I suppose it could have been the top of the swivel axle or the bottom of the trunnion, that bear on the shims, that had worn instead. I tried various combinations, including the new thinner thrust washer plus three thin shims (too thick), but the only combination that came anywhere near was my one new thick shim in place of the original thin shim, i.e. the original (thicker) thrust washer plus two thick shims. This left it with no detectable end-float at all, but the steering did turn freely, and a test-drive does show it self-centres even at the lowest speeds, so in theory is a possibility (but shouldn't be used as end-float **must** be present and the suspension unloaded to allow grease to get through the upper trunnion). But in theory if the thicker thrust washer plus two thick shims gives zero end-float but no binding, then one thick and one medium should give .005" play i.e. less then the specified .008" to .013", and one thick and one thin should give .010" play pretty-well slap in the middle of the tolerance. However this last combination was what was in to start with, and looked to be giving a lot more than a quarter of a millimetre as judged by eye. I want to try one medium washer in place of one of the thick ones, but all I have left now is six thin washers which is unlikely to be any good for the other side. So a phone call to Moss, who say send them back. Fair enough, but simply picking others out of the same bins isn't necessarily going to be any better. They said they would measure the replacements (really!?) and make sure I got two of each, we shall see. In the event I kept two of the thin ones and the one thick one, just returning three thin ones, hoping to get two medium and a thick back. In the event about a week later I get the correct ones, plus an automatic refund of my return postage, which is pretty good. I swapped one of the thicks for a medium on this first side, but when juggling the other side found only the original combination (a thick and a medium) gave any end-float, so I ended up leaving those in.

When you have found the right combination remove the king-pin nut for the last time (and its spacer if used), lift off the trunnion and grease the thrust washer and shims by applying grease directly to them at this stage, not from the grease nipple. Refit the trunnion and king-pin nut (but don't tighten it yet), and insert the trunnion bushes into the trunnion. Lubricate the bushes with a suitable lubricant e.g. Waxoyl to make fitting easier. The bushes have to be wedged into the trunnion before you will get them in between the damper arms, even if the damper arms are wedged apart with an old screwdriver between the bosses of the cross-bolt. Use a plain nut and bolt and large washers of a suitable size through the bushes and the trunnion, to squeeze the bushes in to the trunnion. Even so they are unlikely to push straight in between the arms of the damper, I had to turn the trunnion a bit to get one bush started, then a paint-scraper as a sort of ramp to squeeze the other one in while I pushed on the trunnion. Again Waxoyl on the faces of the bushes (and inside the steel sleeves to prevent rusting to the pin in future) and the damper arms makes this easier.

Make sure you get the trunnion the right way round, the vertical king-pin is INBOARD of the horizontal trunnion pin, not the other way round as is shown in the Workshop Manual and Parts Catalogue exploded drawings!! However the assembled drawing in the Leyland manual is correct, as are both drawings in Haynes. This MGOC catalogue exploded drawing is also incorrect, but the photo of the assembled unit is correct. The Moss exploded drawing is also correct.

Peer though the damper arm, tapping it up or down and the trunnion in or out to get the holes aligned on the side the pin is inserted from, then insert the pin, again lubricating it e.g. with Waxoyl. The pin goes in from the front on the right-hand side so the cut-away on the special head engages with the raised portion on the damper arm (from the rear on the left as the dampers are not handed). Once the main body of the pin has started going through the first bush in the trunnion, peer in from the other side and tap and align that as well, until you can tap the pin all the way through. Fit the nut tightening to 40 ft lb, and the split-pin. Tighten the damper wishbone cross-bolt (wedge removed) to 28 ft lb.

With the top link assembled you can finally tighten the king-pin nut to 60 ft lb. Leaving it loose until now allows the trunnion to take up the correct position and be twisted on the king-pin so the holes in the damper arms will line up with the holes in the bushes. Grease the king-pin as normal i.e. from all three nipples using a grease gun until clean grease oozes out of the joints, and wipe off the excess.

And the result? Just the pigging same! However when pushing the car back and fore to work it across the garage to give me more room for the second side I could hear a clonk as I started turning the tyre on the floor. Getting the Navigator to keep doing that while I looked and felt underneath showed no relative movement between track-rod end and steering arm, or up and down or back and fore movement of the track-rod, but I could definitely feel the clonk in them more than in anything else anywhere round the suspension or rack. Wheel off and there is some very slight up and down free-play in the body of the track-rod end relative to the steering arm, and with them parted the pin is flopping about all over the place, so it looks like new track-rod ends for Vee as well.

Lubrication *March 2014*

As far as routine maintenance goes it's just a matter of unloading the suspension - supporting the body safely with the wheels hanging down - so that grease can work its way round all the bearing surfaces. If it's loaded then it isn't going to get to the surfaces that are passing the weight of the car through to the wheels. You can also work the steering from lock to lock after the initial lubrication, then add a bit more. I always remove the wheels as it gives better access from the sides. Wipe the ends of the grease nipples to avoid pumping dirt in. The fitting on the end of my grease-gun needs to be dead in line with the nipple, or grease escapes rather than going in. Pump till it comes out from under the upper trunnion, and from past the seals each end of the lower trunnion, and wipe off the excess.

Originally there were only two nipples per side - one at the top of the swivel axle and one at the bottom of the king-pin. But this led to inadequate lubrication at the bottom of the swivel axle so a third nipple was added here. On the right-hand side both swivel axle nipples point forwards, but on the left the lower one points backwards. The one in the kingpin screws upwards, and should be an angled nipple (UHN 445) to make connecting a grease-gun easier if the car is on axle stands. It's a bit hit and miss as to where this points, and if not ideal you can slacken it a little to get the gun on without loosing too much grease from the threads, retightening it afterwards.

Both the swivel axle nipples are straight, but they should be of different lengths. Although they are usually shown as the same size in the drawings a short one (UHN 400) goes in the top and a long one (549229) goes in the bottom. This is because immediately above the bottom one the casting bulges out, which means that you can't remove or tighten it with a socket, you have to use a small open-ended spanner. The long nipple has the hex outboard, so can be removed and tightened with a socket. The upper nipple is on a flat surface so a short one can be accessed with a socket.

For some reason Bee had three angled nipples on the right-hand side, which made it awkward to get a grease gun on even on full lock, and as I say above unless it is dead in line grease leaks out from the fitting on the end of the gun. After many years cussing this, I finally got round to getting the proper nipples. Because of the bulge in the casting I couldn't even unscrew the lower angled nipple. But they are usually in two parts, with a short straight piece screwed into an angled piece. So I had to remove the outer part before I could unscrew the body. With two straights, greasing that side now is a doddle.

Leaf Spring Lubrication

Once I started using the V8 in mainly dry weather the rear springs started squeaking quite badly, which had the Navigator complaining. I didn't want to spray oil on them as I was concerned for the rubber bushes at each end, particularly the front bush which is a lot more difficult to change than the rear bushes, so decided to use Waxoyl which doesn't harm rubber. Waxoyl is also much less likely to get washed out from between the springs when Vee does get wet, like on organised runs!

I actually painted it on semi-congealed rather than as a liquid suitable for spraying, then used a hot air gun to melt it whereupon most of it was absorbed into the gaps between leaves and interleaving and little dripped off. At first it didn't seem to have made much difference, but then over a bit of driving it seems to have 'worked in' and they have definitely become much quieter and now I can't say that I notice them at all and neither has the Navigator commented recently. It would have been much easier to apply with the springs removed from the car and laying on their sides, but a much bigger job overall of course.

In response to a question on a Bulletin Board I mentioned this but another contributor said he didn't like Waxoyl because it dried out. In my experience whilst it does 'dry' in that the white spirit that makes it liquid evaporates it leaves behind the waxy stuff which if you rub it between your finger tips is still slippery i.e. does still lubricate, and as I say is much less likely to get washed out than oil or even grease. And being drier it will pick up less dirt and grit.

Update August 2007: Having broken a rear spring on this year's Snowdon Run before I replaced them I laid the new springs on their sides, painted on some dollops of Waxoyl, then used a heat gun to melt it into the crevices between springs and interleaving. When they were 'dry' I could pick them up by the eyes and it was a cleaner job than I was expecting to fit them while coated. Incidentally, this is the third set of springs I have bought from three separate suppliers and fitted to two different cars - one chrome one rubber, including stiffer rubber bumper roadster springs to the chrome bumper roadster, and I have never had any trouble getting the shackles, damper drop-links or rebound rubbers attached, or in getting the shackles to point downwards. The weight of the body was more than enough to compress the springs before the body lifted off the axle stands in all cases.

Lever-arm Dampers

July 2009: All you ever wanted to know about dampers, including the quote "The parallel-piston lever-arm damper was functionally very good, and the fact it has been superseded by the hydraulic telescopic, and the strut in particular at the front, is mainly due to the final assembly advantages of these, rather than any functional gain in the areas of ride and handling". In other words, simply replacing the dampers is a waste of time and money, you would have to go for a wholesale replacement of the suspension system front and rear to get anything approaching modern levels of handling. OK for serious competition maybe (then why bother racing an MGB?) but it destroys the essence of the MGB in the process - that of predictable handling and ease of control.

Front Damper Replacement *Updated October 2009*

Lever-arm dampers are hydraulic (being filled with light hydraulic jack fluid, not oil as such). The usual failure mode of these is for the seals on the shaft that the arms connect to start leaking. Once that happens they are shot, there is no point putting more fluid in, it will just leak out again. A leaking damper can be an MOT (UK annual inspection) failure point in the UK if the tester suspects or finds it is affecting damping. Other than that I have never found any need to check and top-up the dampers, even though it is a routine maintenance item.

When changing a damper for the first time you will almost certainly need a new link bolt and nut and bushes, as each one I have done has had the pin corroded solid with the inserts in the bushes. In both replacements I have done the link bolt was supplied with a Nyloc nut instead of the original low-profile castellated nut and split-pin. In neither case was the bolt long enough - or the nut low-profile enough - to be fully tightened - with a Nyloc nut there should be about three threads clear of the bolt, but the bolt barely reached the Nyloc let alone go through it. Fortunately the bolts were drilled for a split-pin and I had a suitable low-profile castellated nut in each case. **Do not use a Nyloc nut without there being at least three threads visible with the nut fully tightened, the bolt could come out in use.** Before paying for dampers check they move smoothly (and heavily damped through their full travel and back to the centre, then wiggle the arms up and down near the centre and make sure there is not slop as they change direction. Exchange dampers where you return the old one is much cheaper than buying new, and the rebuilt replacements are usually of reasonable quality. But as the rebuild is only as good as the original it is possible to get a duff one that fails after quite a short period, however it is still much cheaper to have to change it again fairly soon than to buy new. Out of three replacement lever-arm dampers I had to change a rear one for a second time after only a year or so, its replacement and the other two have been fine. At the time of writing I have just replaced another one so the jury is still out on that. *Update October 2009* Annoyingly that started weeping after a year or so, but lasted a further couple of years and MOTs before it got bad enough to start dripping on the floor, which was when I changed it again. Hopefully better luck this time.

Raise the front of the car by jacking under the rear edge of the cross-member (if you jack further forwards than that it will slide further forward in a series of sudden and noisy movements which is a bit disconcerting. Place axle stands under the outer edges of the spring pans, and lower the jack just enough to lift the damper arms off the rebound rubbers. **It is important to do this otherwise when you remove the top link**

bolt the axle assembly and hub will shoot downwards as they are under significant spring pressure.

Next comes removal of the top link bolt connecting the damper arms to the swivel axle. Easy to say, much harder in practice. The bolt runs through the arms of the damper and steel sleeves in the rubber bushes. It is a snug fit in both and unless it has already been replaced fairly recently or was assembled using Waxoyl and copper grease it will almost certainly be well rusted to both. The rubber bushes will probably also have deteriorated and be bonded to the eye in the swivel axle. In two replacements on may cars this has been the case and I have had to hacksaw through the bolt both sides of the swivel axle eye. On a second replacement of one of them everything came apart very easily.

Remove the nut on the end of the link pin, it is usually castellated with a split-pin. Slacken right off the clamp-bolt holding the two arms of the damper together, and drive a wedge between them to lever the arms apart and give you more room to cut through the link bolt.

Use a length of cable or whatever to tie the swivel axle to the bracket of the bump and rebound rubbers to prevent the axle falling outwards and stressing the brake hose when the link pin has been cut through or removed.

You can try driving the link bolt out of the bushes and arms, but it shouldn't take much hammering to realise it isn't going to shift. If not, cut the flange off the end of each bush by chiselling and cutting at an angle into the eye of the swivel axle. This reveals a section of link bolt on each side to cut through without damaging the inner faces of the old damper (which might then be rejected as a core replacement) or the swivel axle eye. Use a hacksaw where you can turn the blade at 90 degrees to the frame and this should allow you cut inwards and upwards each side. With a decent blade it shouldn't take many minutes to cut through both sides, and the damper arms can be lifted up from the swivel axle eye. Remove (it really should be that easy) the four bolts securing the damper body to the cross-member. I use a universal joint between the ratchet and socket, it gives that extra depth for all four bolts and a bit of angle for the back ones where the inner wing curves over them. Lift the damper away - it is heavy!

Now you have to drill, cut, twist and hammer the old bushes and remains if the link bolt out of the swivel axle eye, they will probably come out as a single piece, which can only be done if you have previously removed the flange from the bushes as previously described. Remove any lumps of rubber that are stuck in the eye as this will make insertion of the new ones more difficult.

Check the fluid level in the damper now, it's easier. If you find you have to add a lot, or in any case after transportation where they may have been at a different orientation to when fitted to the car, work the arm up and down it's full travel several times to expel any air from the valves. Remove any dirt or grit from the cross-member where the damper will sit. At this point I put a bit of copper grease into each hole in the cross-member, then put the damper in position. Coat each bolt with copper grease and insert just a few threads, don't tighten them any more than that until all four bolts are started. Again slacken the clamp-bolt holding the two arms together and wedge the arms apart to fit over the bushes. This is necessary when leaving sound bushes in the swivel axle, not just for new ones.

Coat the outside of new bushes and the inside of the swivel axle with Waxoyl and insert the bushes. They will probably be much wider than the gap between the damper arms even if they are wedged apart. You can either put one or more large nuts over the threaded end of the link bolt then tighten its nut to squeeze the bushes fully into the eye

or use a small sash-cramp or something similar. Eventually you should be able to get the bushes far enough in and the damper arms far enough apart to fit the two together, but before you do so put some copper grease inside the steel sleeve of each bush, wiping off any excess from the rubber.

Place the damper arms over the bushes, put more copper grease in the holes in the arms and on the link bolt. Tap the bolt through the appropriate damper arm the bushes, and the other damper arm. Note that the bolt has a special round head with one flat which engages with a recess on one damper arm. This is the front arm on the right-hand side, the rear arm on the left, therefore the bolt can only go in one way each side. Things might need a bit of wiggling about while you are tapping to get everything lined up.

Note where the split-pin hole is in the bolt and fit and tighten the nut (40ftlb). This has to clamp the damper arms onto the ends of the bush sleeves, and the inner ends of the bush sleeves together, so it does up tight. The final position of the nut should allow insertion of the split-pin, of course. Refit and tighten the damper arms clamp bolt (28 ft lb). As the four mounting bolts allow a little wriggle-room for the damper now is the time to use it to try and correct any tendency to pull to one side or the other on a flat and level surface (note a normal drainage camber will cause the car to pull to the kerb side slightly). Pulling to one side or the other is caused by unbalanced camber, not by tracking as many think. Which ever side the car pulls there is more camber that side than the other, so pushing the damper arms **forwards** as you tighten the four bolts (43-45ftlb) will tends to reduce it, and pulling the damper arms **backwards** on the other side will do the same. It may not do much but is worth a go while you are at it. Refit the wheel and away you go. Inspect the new damper from time to time in the early days just in case you have got a duff one, and always before an MOT.

Rear Lever-arm Dampers *August 2009*

Replacement

The damper, drop-link, rebound rubber and bump-rubber pedestal (and for that matter spring) must be treated as a set for correct and safe operation of the rear suspension and these vary from model to model. Whilst the damper obviously controls the rate of spring compression and expansion through the normal working range, the compressed limit is controlled by a pedestal on the axle hitting a bump-rubber under the floor, and the expanded limit is controlled by the rebound strap which is fixed between a body and axle. The final component is the drop-link between damper arm and spring/axle assembly. In an ideal world the spring, in it's normal working position, will position the axle about mid-way between the fully compressed and fully expanded positions, and the drop-link length should be such that the damper is also about mid-way in its travel. The loading on the car could be a little as a single occupant, or it could be two people plus tools and luggage with the consequent compression of the spring, so maybe a median between these two is chosen by the designer as the 'central' position. Whatever, it is vital that the drop-link, rebound strap and pedestal are installed as a set so that it is the rebound strap and bump rubber that provide the limits to axle movement and not the damper itself. Get these wrong and the damper will suffer damage. In theory it doesn't matter as much if the spring varies in set or hardness, as the other components will limit axle travel regardless and so protect the damper. But if the spring is too soft or flat you will be hitting the bump rubbers over relatively small bumps (been there, done that, extended the shackles) or at the other extreme the car will have a very tail high ("submissive monkey") stance and be hitting the straps relatively easily. Whilst hitting the bump-rubbers is merely uncomfortable, continually 'hitting' the rebound straps will eventually break them, and then you will start hitting the damper limit and damaging that.

Chrome bumper 4-cylinder cars had one set of drop-link, rebound strap and pedestal, chrome bumper V8 had a different set, and all rubber bumper cars had a third set in this case the same for 4-cylinder and V8. I know chrome bumper V8s had a higher ride height to 4-cylinder chrome bumper cars to improve the exhaust to ground clearance, utilising a different front cross-member that was later commonised to all rubber bumper cars. The rear spring hangers were lowered at the front and the rear on all rubber bumper cars i.e. 4-cylinder and V8, but they differed between chrome bumper 4-cylinder and V8 cars as described here. Hence all rubber bumper cars have the same damper and axle movement limiting parts, even though the V8 springs are harder. The combination of parts for each model from the Parts Catalogue is as follows:

Model	Armstrong catalogue	BL catalogue	Drop-link	Rebound strap	Pedestal
4-cyl chrome bumper	8178LH/RH	GSA168 LH 169 RH	97H 2031	AHH 6355	AHH 7335 Note 1
V8 chrome bumper	10801LH/RH	GSA328 LH 329 RH	37H 8075	BHH 989	BHH1030 Note 2
4-cyl rubber bumper to 76	12012LH/RH	GSA368 LH 367 RH	37H 8778	BHH 989	AHH 7335 Note 1
V8 rubber bumper	12012LH/RH	GSA368 LH 367 RH	37H 8778	BHH 989	AHH 7335 Note 1
4-cyl rubber bumper 77 on	12075LH/RH	GSA368 LH 367 RH	37H 8778	BHH 989	AHH 7335 Note 1

Note 1 - Corrected May 2014 following a note from Bob Paquette.
Note 2 - NLA, parts suppliers say to use AHH7335. The original part was taller, which would limit how close the axle could get to the body. You need to check the increased axle travel with the alternative part doesn't bottom the lever-arm damper. If it doesn't, one wonders why it was different in the first place.

Note the same rebound strap is used for CB V8s and all RB cars, and the same pedestal for all 4-cylinder cars and rubber bumper V8s. The Parts Catalogue only specifies one bump-rubber (AHH 9158) for all cars.

Peter Caldwell of Wisconsin posted the following information on the MGCars BBS as part of a thread on this subject in December 2006:

> "Armstrong conveniently stamped their part number on every shock (except for Spridget fronts which were cast). On all rears the number is stamped on the underside of one of the mounting ears. B rear shocks will have 8178LH or RH, or 12012 or 12075 (LH, RH).
> "Per Armstrong's 1978 USA catalog... 8178 fit all B and GT (4 cyl) through 1974 (The 73 and 74 BGT V8 used 10801 which I've never seen). All models 75 through 5/76 used 12012. Then all models 6/76 to end used 12075. Again, I've seen absolutely no difference in the 8178, 12012, 12075. I suppose if matching, check that the numbers are the same."

His dates more or less tie up with what is in the BL Parts catalogue and so allows us to associate the Armstrong numbers stamped on the items with the catalogue numbers and hence models. This might seem rather pointless if the damping is all the same, but remember there were many other applications for these dampers and hence many other

Armstrong numbers, many of which are bound to have different damping characteristics, and this makes the Armstrong numbers very useful when buying second-hand units where you cannot be sure of the original source.

Rear Damper Replacement *Added October 2009*

Ostensibly two nuts and three bolts, but it can still be a bit of a bear to remove. If you haven't changed them before the nut (11/16") will likely be corroded to the drop-link pin in the damper arm, and nut and pin will turn as one. With units that haven't been on long and correctly assembled with copper-grease the nut will probably come undone but you won't be able to break the taper between pin and damper arm. Fortunately it is easy to remove the damper complete with drop-link and spring bottom plate and deal with them on the bench.

Important - chock the front wheels. Slacken the road wheel nuts a smidgen if the handbrake isn't up to much. Support the car at the front spring eye or hanger on axle stands by jacking under the axle or spring bottom plate. Lower the axle until the car is resting on the stands, then remove the road wheel. Continue lowering the axle to give you more room to work, but observe the condition of the rebound straps before trusting the full weight of the axle to it. Remove the nuts (11/16") and spring washers from the bolts (5/8") holding the damper to the chassis rail, turn the bolts to free them up, but leave them in-situ for the moment.

Undo the U-bolt nuts (9/16" deep socket), which will allow the spring to push the bottom plate and damper drop-link fully downwards. If necessary jack under the spring one side of the bottom plate or the other to raise the spring off the bottom plate and so take any tension off the damper to chassis rail bolts. Supporting the damper remove the chassis rail bolts and lower the whole assembly down off the ends of the U-bolts and away from the car.

With rusted drop-link nuts I had to hacksaw at an angle part-way through the nut then chisel the cut open to free the nut. Because the pin had been turning in the damper arm this came out relatively easily. Where the nut came undone I left it screwed on so that the outer face of the nut was flush with the end of the pin, supported the bottom of the arm or plate on a solid object, and struck the end of the nut and pin to free the taper.

Check the fluid level in the new dampers before fitting. If you find you have to add a lot, or in any case after transportation where they have probably been lying down, work the arm up and down it's full travel several times to expel any air from the valves. Push fit the bolts to the chassis rail, noting that later cars have the 'outer' bolt head in a recess in the wheel arch to give better clearance for the wider tyres on GTs and particularly V8s, and this bolt is shorter than the other bolt. Offer up the damper to the bolts and fit the lock-washers and nuts. Fit the bottom plate with drop-link over the ends of the U-bolts and loosely fit the nuts, then position the damper arm so the drop-link pin can fit through it and fit its washer and nut. Tighten all nuts (55-60 ft lb for the damper to chassis rail nuts).

Hydraulic Damper Fluid *Added November 2009*

Needless to say there are strongly-held views on what fluid should be used. The Workshop Manual states "Armstrong Super (Thin) Shock Absorber Fluid No. 624. (If this fluid is not available any good-quality mineral oil to specification SAE 20W can be used, but this alternative is not suitable for low-temperature operation)." It doesn't specify what it means by 'low temperature' but looking at the lubrication chart for the engine anything consistently below 10C/50F is considered 'cold' and anything consistently below -10C/15F is **very** cold! However the 'standard' temperature range

goes down to -10C/15F, so maybe if don't go below that at any time you would be OK. But I can remember it getting as low as -27C some years ago in the UK, although that was before 'climate change'. I've always used hydraulic jack oil (Halfords £4 for 500ml) and never had a problem, although others claim that foams which destroys damping. Still others claim that claim is rubbish, foaming in jacks would be a bigger problem than in dampers! Motor-cycle fork oil is frequently mentioned as it is said to have a seal swelling agent which reduces the chances of leaks over time. Available in various viscosities from 5W to 30W, you would probably want to keep to 10W or 15W. Halfords also sell 'Halfords Central Hydraulic Fluid' at £15 per litre said to be suitable for 'certain' power hood, suspension, traction control and central locking systems, but it seems to be for modern cars and their highly sophisticated systems. Moss sell 'shock absorber oil' (for a start they are dampers, the springs are the shock absorbers, and it isn't really oil but hydraulic fluid) at £8 for 473ml. A certain authenticity in the quantity, I suppose, being 16 oz i.e. Imperial like the rest of the car.

Topping-up

There is further scope for argument over fluid level, believe it or not. The Workshop Manual simply says "fill to the bottom of the filler plug hole". But some say it should be half an inch below it on the rears to allow an air space to absorb up fluid expansion on heating up, otherwise it could be forced past the seals. But if that is correct, why doesn't the manual say so? I then started thinking about the positions of the filler plugs, and realised that with the front damper filler plug on a vertical face of the damper body, filling to the bottom of the hole will still leave a significant air-space above it. But the rear dampers have the filler plug on top, which may not unless there is an air-space under the lid i.e. above the bottom of the filler plug hole. When I converted Vee from telescopics back to lever-arms I bought a 'kit' containing dampers, drop-links and bottom plates second-hand from some unknown MG at Stoneleigh, and it was only when I decided to recheck the fluid level some time after fitting them that I discovered the filler plug hole was also on a vertical face, and not on top as they should be! "Ah ha", I thought, that would leave an air-space in the rears as well, and maybe that part of the manual had been copied from that for another vehicle where both front and rear filler plugs **are** on a vertical face. But looking again in the manual not only does it show a top-fill rear damper, with instructions to remove the plastic plug in the chassis rail to access it, but it also shows the front damper with a top-mounted filler-plug! So from there being an obvious air-space above the fluid on both types, there could be none on both types! When Vee's rear dampers started leaking (after having lasted a few years, I was quite prepared to change them at the outset as they were an unknown quantity) I got the correct top-fill ones of course, and checking the level before fitting found that it was indeed about half an inch below the bottom of the filler plug hole. So that's good enough for me, and having found with leaking dampers that the fluid level can drop a long long way before it affects damping, leaving a half inch gap below the bottom of the filler plug hole on the rears is neither here nor there, and at least you are sure that there **is** then a clear air space, if that makes a difference.

Internal Valving *January 2015*

Sven Hinrichsen wrote to me from Germany asking if I could offer any advice on internal valving, as he had several sets of dampers purporting to be for the same car but with quite different internal components. I couldn't help, as I've never had any spares or old ones as when I have needed to replace any it has been part-exchange, as it were, with the old ones going to the supplier of the new. However I said I would be interested to hear of anything he did find out, to include here. He subsequently received some advice from Peter Caldwell which he passed on to me, and I reproduce his 'conversation'

with Peter below. Incidentally Sven is in the process of building an MGB GT with an electric power source for urban commuting, read all about that here.

Hi Peter, I'm Sven from Germany and I'm restoring an MGB GT and converting it to electric drive. I write to you because I cannot find information on the setup of the Armstrong shock valves, and in this forum you are referred to as being the specialist on these. There is nobody here in Germany and Europe who can tell me which are the exact parts for original front and rear shock valves. Disassembling several valves revealed different setup for left and right shocks even for reconditioned pairs fresh from the counter... Let me give you a short overview:

Plug screws differ in having an o-ring or not (I don't think this affects damping characteristics) and they come with two or four drilled holes.

On outer springs I could find some information, they mainly differ in wire thickness and no. of windings (and colour), original MGB specification is the blue version with approximately 2.1mm wire thickness and approximately 5 1/3 windings. Some were built in together with washer(s), some not.

The inner valve part differs in no. of notches or cut-outs (1 or 2) at the top of the tapered part and the inner pin taper has two diameters, additionally there are also different springs.

You can see the outer cone of the valve with the green arrow indicating a ring of marking of the valve seat in the plug screw. The inner cone (red arrow) is in its seat in the outer cone. The "inner pin taper" is marked with the blue line, and the yellow arrow points to the notches or cut-outs in the outer cone. Some of my valves have two of these, some only one. I think, it affects the damping of the inner valve by letting more oil pass through when the valve is slightly open and even more when there are two of them...

Sven

Sven, There ARE different valve designs that vary by the generation of casting by Armstrong. Remember, the same design was made by Armstrong from 1962-1990. There were many small differences in the valve as determined by the small changes in the castings. We hope that Armstrong made the valve changes based on damping characteristics they could test on a dyno. I can't tell you what should be in the castings you have, but I CAN tell you not to over think this. It doesn't make a huge difference from a street driven perspective. We do make an externally adjustable shock that may interest you as you try to find the best spring rate for your application. Peter

Hi Peter,
And thanks for your quick reply. Your statement 'It doesn't make a huge difference from a street driven perspective' helps a lot, because with my EV conversion I will drive 95% in the city and the top speed will not exceed 110 km/h. So I'll just keep an eye on assembling the right hand valve identical to the

left hand valve.
Thank you again and best regards,
Sven

You want to be sure that the main valve body, the part with the hex nut, is correct for the casting. 1 takes an o-ring with washer, and 1 without. There is a depth difference, too. Good luck. Peter.

Okay, so I will also have a close look at the cast bodies of the shocks...

Telescopic Dampers - or "Nix to Spax" *April 2006*

The V8 came with telescopic Spax dampers at the rear fitted by the PO. After only a few thousand miles one started leaking, and as I couldn't get a direct replacement I had to buy the pair. And at about £60 as opposed to about a tenner for a single reconditioned lever-arm unit I was not best pleased. It also took Moss three attempts to get the right ones to me, there are two different bottom pin sizes and they kept sending me the wrong one, but that is a bit by-the-by. Having driven roadsters and V8s both with and without telescopics and the rear anti-roll bar and uprated front bar, I can say that whilst the anti-roll bars **do** have an effect on handling and axle location I could detect no real difference between the two types of damper. Click on the thumbnails below for full-sized images.

The replacements lasted for many tens of thousands of miles (no more than one should expect) but I had been aware for a while that the ride was getting quite bouncy, especially over humps and dips. The USP of the Spax is their adjustability, but unless you have them on the softest setting they give a bone-jarring ride, and many testify to this. Thinking that they may have 'softened up' over the 70k or so miles they have been on the car (which itself is a poor 'feature') I tried turning the adjusters, but needless to say they had seized, and I decided that I would not replace them when the need next arose but go back to lever-arms. However I was concerned that if one should fail, unless I splashed out again for a replacement (or possibly a pair), I might have to take the V8 off the road for a time while I sourced a pair of lever-arms together with the drop-links and bottom plates. So at the 2006 Stoneleigh MG Spares Show I was on the lookout and managed to pick up the whole lot minus one bottom plate for a tenner, and got a used bottom plate from elsewhere for another fiver. They were already assembled but I wanted to part them for cleaning and painting, but as usual (IME) the nuts had seized. **TIP:** Careful hacksawing as far as I could through the nut without cutting into the studs (OK, I just nicked the threads, but that won't affect its strength) then using a cold-chisel to open up the cut cracked the rust and it came undone. Using heat is inadvisable is it is bound to damage the rubber bush the stud is mounted in, which is not a replaceable item. That left me needing a couple of nuts, which being Imperial are not that easy to come by. Popped down to my local Halfords where the chap who usually MOTs all my cars had a root through his toolbox and came up with exactly what I needed (That's **another** pint I owe you ...).

I then discovered that despite measuring two lengths of drop-link at the show, and thinking I had got the longer V8/rubber bumper items (10 5/16" pivot pin centre to pivot pin centre, thanks Graham), I actually ended up with the shorter CB items (8 3/4"). Only discovered this as part of an email thread with someone else, who had the longer ones and needed the shorter! Sadly he was in America so a swap was out of the question. Rather than buy another pair I decided to try 'cutting and shutting' them to extend them (as I had with the rear shackles on the roadster) by the required 1 1/2" or so. Looking round the garage I

found a couple of front suspension bottom trunnion bolts that were the correct (0.5") diameter and did the necessary cutting and welding. Two coats of Hammerite smooth on them and the bottom plates and they were ready to go on.

I was quite surprised to find the U-bolts and the nuts and bolts holding the top brackets to the chassis all came undone quite easily as they had not been touched in my ownership, likewise the replacements went on straight-forwardly, the whole job only taking a couple of hours. **TIP:** The only thing to be aware of is that the two bolts holding each damper to the chassis rail are different in length by about 1/4", which could cause you some head-scratching if you get them mixed up and the two shorter ones on the same side. At some point the forward bolt was recessed into the chassis rail to give more clearance for tyres, possibly for the wider tyres on GT and V8, the shorter bolt goes in this position.

Took the car for a test drive and immediately noticed that on 'normal' surfaces the ride seemed exactly the same but over humps and dips there was no bounce, just a more appropriate firmness without harshness. The standard lever-arms have a two-stage valve that gives relatively mild damping with short movements and harder damping with larger movements, something I have never seen attributed to telescopics of any type. I was deliberately taking the car over as many speed humps as I could find, and going at them progressively harder, when I actually broke one of the welds. It was my fault, when doing the first one I became aware that I was feeding the wire too quickly, which tends to form bobbles of weld on the surfaces of the two pieces being joined rather than fusing them together. No matter, 1/2 hour to take the broken drop-link off, clean up the joint and re-weld, but this time I slipped the spacer tube from the aforementioned bottom bolt (exactly the right internal diameter) over the shaft first, then welded the shaft, then positioned the spacer tube so it covered both welds, and applied more weld between spacer and shaft. Repainted, refitted a couple of days later, and so far so good.

Rack Gaiters

Using wedges and pickle-fork so-called ball-joint splitters I had never been able to disconnect the track rod end from the steering arm without damaging the rubber boots on them i.e. destroying them in the process so unless I was changing them anyway I didn't even try. You can either unbolt the steering arm from the swivel axle which is easily done or just unscrew the tie rod from the track rod end rather than vice-versa. You may have to remove the tie or clamp on the small end of the gaiter in order to turn the rod without twisting up the gaiter. Eventually I bought a ball joint separator but had to modify it. Now splitting track-rod end tapers is a positive joy.

*Update August 2010:*A tip when disconnecting the track-rod ends from the steering arms. The nut is usually a Nyloc, and the effect of this is that once the taper is broken you can't turn the nut on the thread without locking the taper again, as the stud just turns in the ball-joint. And if using a screw-type splitter you really need to have a nut on several threads if you are to avoid damaging the end of the stud. The tip is to remove the Nyloc nut, then put a plain nut on until the end of the stud is close to the face of the nut, before using the splitter. As long as the threads are good the plain nut will be much easier to remove once the taper is broken. For replacement the same problem occurs, so screw the plain nut up tight to lock the taper, then replace with the Nyloc nut.

But I digress. Make alignment marks on the tie rod and track rod end. Slacken the lock-nut and count how many turns are needed to separate the track rod end from the tie rod. Change

the gaiters then screw the tie rod and track rod end back together the same number of turns it took to part them, finishing with marks aligned, assembling with copper grease to aid future removal/adjustment. Fasten the tie or clamp on the smaller end of the gaiter, but not so tight that the tie rod can't be turned without twisting up the gaiter during future tracking adjustment. If changing both gaiters fasten the tie on one big end but leave the other off for the moment and use an oil gun to inject 1/3rd pt (0.4 US pt, 0.2 litre) of the same oil as is used in the rear axle i.e. EP 80W/90 GL-5 or equivalent into the big end. Hold the bottom of the gaiter up against the rack housing while you inject the oil using a small oil gun in the top, periodically moving the rack slowly from lock to lock to distribute the oil.

Update Autumn 2005: If you put your hand over the top of the big end of the gaiter with the thumb down one side and forefinger down the other you should be able to squeeze and stretch the gaiter such that the bottom half is stretched into the groove of the rack to make a reasonable seal while you are injecting oil, and stretch the top half so that you make a small loop, or at least an area of lessened tension, to allow you to insert the nozzle of the oil gun. However if the shape or size or your oil gun prevents its insertion you could try this tip sent to me by Michael Beswick: "I found a 8" piece of windscreen washer tube, cut one end at a shallow angle to make a bit of a point. The other end I put in boiling water before forcing it over the pointy end of a biro. I left it for a while and the result was a small funnel shape that the nose of my oil can fitted into neatly. I released the clip on the gaiter, put the tube in at the top of the gaiter and managed to get it all over the metal fitting. Tightened the clip to just nip the whole assembly. Inserted oil can in the funnel end of the tube (it was quite soft so the oil can spout fitted reasonably tightly) and hey presto! A little care is needed or the tube blows off the spout. Remove oil can and carefully pull out the tube (which can be kept in the right plane)." Finally, fasten the remaining big end tie or clamp.

You **should** be spot-on, but unless you know your tracking was right before there is no harm in getting it checked, and you know you will be able to slacken and adjust everything before it all seizes up again.

Rear Bump Rubbers and Pedestals *January 2011*

Pedestals

Bump Rubbers: Just seen a top tip on the MG Enthusiasts BBS from Fletcher Milmore on how to fit new Bump Rubbers, which really appeals to my love of lateral ideas. The hole in the rubber is quite a bit smaller than the peg they are supposed to fit over and people often complain what a chore it is. Fletcher's method is:

> "Clean up the stud, lubricate with something that doesn't eat rubber. Measure the gap between the axle and the rubber and get a block that will fill the gap. Put the rubber in position and jack the axle up so the rubber is supporting the car's weight. Might take a few minutes sitting, but it will pop on."

At least, that is what seemed to work for Fletcher. Herb Adler found even that didn't work, so had to come up with an additional step, as described here.

Bump Pedestals: *October 2016*

These rot over time, and collapse if your suspension is anything like mine and bottoms over bumps when touring fully laden. If they crumble away altogether you may find the lever-arm damper ends-up limiting axle travel, which won't do it any good at all. I could see one of Bee's had holes and become partially crushed, so ordered a pair (AHH7335 at about a fiver each so not expensive) the next time I was ordering some other stuff. Before starting check the rebound straps also need to be in good condition, and get some in if they are in poor condition. However they have their own issues!

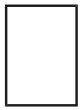
Support the rear of the car **securely** on axle stands by the rear spring front hangers, so the axle can hang down and give you more working space above. Take the road wheel off.

Jack under the spring to raise it an inch or so. Undo the U-bolt nuts working round all four bit by bit, rather than fully removing each in turn. With the spring supported and raised a bit you should be able to pull the damper plate down off the U-bolts and push it out of the way, also remove the bottom spring retaining plate below the rubber pad (which can remain in place if sound). The U-bolts may need to be tapped up a little to get the two plates off. Check the pads and replace if required.

Tap the bottom of the U-bolts gently bit by bit up to the bottom of the upper spring retaining plate, and wiggle the bolts complete with pedestal out of the plate and off the axle.

With the pedestal upright swivel the U-bolts through 90 degrees i.e. horizontally instead of vertically as fitted so a straight part is under the pedestal pad, then you should be able to pull them all the way out. If the pedestal has collapsed you may need to exert some force to remove the U-bolts from it by levering the pedestal pad away from the curved section that goes round the axle. If the U-bolts show any thinning from corrosion they should be replaced as well.

Protect the new pedestal as required. Feed the U-bolts in sideways under the pedestal pad - with chrome bumper pedestals you may well need to lever the pad away from the curved part even on new pedestals to get the end of the U-bolt past the pad without damaging the threads - then turn to point downwards.



Fit the assembly onto the axle from above. You may find you have to 'spring' the ends of the U-bolts in a little to get them through the upper spring plate. If you can get one end through, put a nut on a couple of threads to retain it while you are pressing the other end in. Without this you may find that as the second end goes in the first pops out again.

With all four ends in, tap downwards past the spring so the pedestal is sitting on top of the axle.

Fit the lower spring locating plate over the end of the U-bolts, again putting a nut on a couple of threads to retain one end while pressing the other end in. The damper plate should fit straight on.

Fit and tighten all four nuts bit by bit working round each in turn once they start to compress the rubber, checking the pedestal is level on the axle i.e. has equal clearance from its lower edge to the guides on the axle. There is no torque for these nuts as typically they will be Nylocs, so you will just have to use your skill and experience to know when to stop. With new rubber pads you may well have to retighten two or three times as they settle. If you find you have rear-end steering as you accelerate and decelerate, then they are loose. Also if you see orange staining where the axle butts up against the upper spring locating plate they are loose.

Rear Springs

Mounting
Replacement
Specifications

It is purely the leaf springs that locate the rear axle in the car, nothing else. Just in case you wondered how much it moves around under acceleration and cornering forces, have a look at this Healey video which has much the same leaf spring and lever arm damper arrangement: https://www.youtube.com/watch?v=tN-4LLAKlpw. Note that the movement is nothing to do with the lever-arm dampers, telescopics would make little if any difference. You would need a multi-link system to positively locate it against rotation about the half-shafts and sideways movement.

NEW **Rear spring mounting** *June 2016*

It's well known that rubber bumper cars higher ride height is obtained by a modified crossmember at the front and lowered spring mounting points at the rear, and this applies to both 4-cylinder cars and V8s. Also that the V8 chrome bumper was the first to use the modified crossmember as it needed more ground clearance for the exhaust than the 4-cylinder. But what about the rear springs on chrome bumper V8s? Over the years I've seen arguments as to whether the rear mounting points on these cars were lowered or not, and I've been intrigued as to the answer. At a recent MG run I had the opportunity to find out as there were not one but two chrome bumper V8s. When parked up at the finish I happened to see the cars, no owners in attendance to ask, so I took some surreptitious pictures.

The results were quite interesting: Both 4-cylinder and V8 rubber bumper cars have lowered front and rear mounting points consisting of a deeper front bracket and the holes for the rear shackle pins being below the centre-line of the chassis rail, but the chrome bumper V8 only has deeper front brackets, the rear points are through the chassis rail just like the 4-cylinder car. Even so the front brackets **are** different between chrome and rubber bumper V8 - the rubber bumper part looks deeper than the chrome bumper, and has a reinforcing piece. Whilst British Motor Heritage lists rear spring front hangers, it only differentiates between chrome bumper and rubber bumper, V8 is not mentioned, ditto Brown & Gammons and Moss Europe which quote the BMH part numbers.

Rear spring replacement *November 2010:*

June 2016: I've just become aware of a news item posted in 2015 on the West Cheshire MG Club website (scroll to the bottom) saying that BMH guarantees correctly specced springs made by GB Springs. However I can find no reference to them on the BMH website. But GB Springs on their website do list what looks like the full range for the MGB at least, plus for other models and marques.

August 2007:

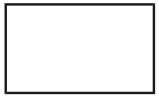
Spot the difference. Following the breakage of a rear spring on the V8 on the 2007 Snowdon Run I ordered replacements from the MGOC and approached fitting them with some trepidation. Would I have the same over-arched/too hard springs that so many seem to have? Would I find the bolt seized in the front eye bush that Americans frequently complain of? In the event I had neither. The front nuts came undone easily with nothing more than a spanner, and when the shackles and U-bolts had been undone and the rear of the spring lowered to the floor the bolts just tapped/twisted out. With the new springs fitted and the weight on the car there is a decent amount of slack in the rebound strap, about 3 1/2" between the top of the bump-stop pedestal and the bottom of the bump rubber, and about 15 7/8" measured between the centre of the wheel hub and the bottom of the trim strip.

On fitting the new springs one point that did differ on the rubber bumper V8 compared to the CB roadster (both CB roadster and RB roadster springs on this car) is that on the V8 I only had to lift the springs up by hand and I could insert the shackles. On the roadster I can remember the new springs being too short, and had to jack under the spring to slide the rear eye back along the chassis rail until I could get the shackle inserted. One problem I had with the V8 that I hadn't had with the roadster with either new red poly bushes at one time and new rubber another, is that the latest bushes have a significantly thicker flange than before, which meant that even without the lock-washers I couldn't get the nuts started. I had to squeeze the sides of the shackle together with a small sash cramp to compress the bushes before I could get the washers on and the nuts started. Other than that everything was straightforward, the only complication on the V8 being the Hopkinson anti-roll bar. To get the bracket of this located on the U-bolts I had to jack under the spring until the bracket was just below the end of the U-bolts, then slowly lower it whilst locating the bracket holes over the threaded ends, until enough thread was sticking through to get the nuts started. Both the front eye bolts and the shackle nuts are done up until they suddenly come tight as the front hanger butts up against the bush sleeve, and the shackle pins have shoulders which the closing plate clamps down onto. How tight to do the U-bolt nuts is always an awkward question - I've never seen a torque figure given, so how tight do you go? Having done this job several times now it seems to me that as you start to compress the flat rubber bushes either side of the spring the nuts get stiffer quite gradually, then they seem to get quite a bit stiffer quite quickly. This is about the point I stop, but they need checking again after a short shakedown drive, and again several hundred miles later (checking the front eye bolt and the shackle nuts as well this time). During my shakedown drive I noticed some creaking coming from the right-hand side, on my return I could tighten this side quite a bit more (possibly as I did that side a couple of days prior to the left-hand side) and on a second run the creaking had disappeared. One thing that did **not** change was the rear ride-height.

One thing I did which I usually do when re-fitting MGB components, to ensure easy removal in the future, is to coat the front bolt and bush and the rear shackle pins and bushes and the rear chassis holes with Waxoyl. Before fitting I had also laid the springs down on one side, painted a decent layer of Waxoyl on, then ran my heat-gun up and down to completely melt it into the joints between springs and interleaving. When that had solidified I turned them over and treated the other side. Not even that messy when picking them up to fit to the car, and that is what latex gloves are for.

So I have now bought three different types of spring, from three different suppliers, over a period of years, and fitted them to two different cars, and never had the 'too-hard/arched' problem that so many complain about. Am I just lucky? Or is everyone that gets this problem buying from dodgy suppliers? Or are they simply not installing them correctly? I wish I knew.

July 2010: A pal's MGB fails its MOT with a broken rear spring.



Unlike the V8 it wasn't obvious as the wheel was still central in the wheel arch, as this car has the factory rear anti-roll bar which controls the fore and aft position of the axle. I suppose the ride height might have been a little lower that side but it wasn't obvious. Keith brought it round, but when the door bell went I hadn't heard the car, apparently it had conked out round the corner! This time (on the last visit it conked out two streets away, so an improvement) a fuel leak had developed and emptied the tank. A short push to a convenient slope allowed the car to roll round the corner and onto the drive, so that was going to be the first job. In the event the rubber hose between the pump and the metal

pipe leading to the carbs had split, so an easy fix, and I was able to manoeuvre the car into the best place for the spring change.

For security I drove the front of the car up onto ramps, with the front of the car pointing down the slight slope on my drive. The rear was supported on axle stands just in front of the front eye, with pieces of wood inserted into the flanges of the bracket between the floor reinforcement section an the axle stand. If one end is on its wheels and you are pulling an pushing at things it's very easy to tip stands over, particularly if its the front on the ground and the rear in the air, even with chocks.

This time not so lucky as both front eye bolts are seized in the spacer tubes. I can turn the bolt with a spanner, but as I release the pressure I can feel them springing back a bit, so the spacer is turning inside the rubber bush. Pondered cutting through with a jig-saw, but they can only cope with a few mm of metal, so opt for a cutting disc for the (4 1/4") angle-grinder. Only had grinding discs before, which are thicker and have an off-set flange. Discovered that with the thinner, flat cutting disc the locking ring has to be turned over so the flat side contacts the disc, as otherwise it isn't gripped.

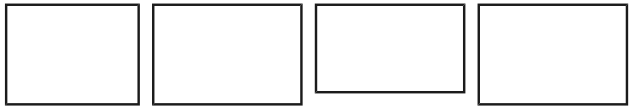
Decide to cut the spring off the eye as close to the eye as I can, to give me as much space as possible to cut up the sides of the eye and through the bolt and spacer tube. I was gobsmacked at how quickly it made the first cut, probably less than a minute, and with that out the way the other two cuts probably less than 2 minutes each. Angle the grinder for the first cut so the sparks fly away from the car and not under it, and downwards for the other two cuts. This meant that with one of the cuts each side it didn't go through all the way in one go, so just turn the eye 180 degrees and cut through the rest. The eye just dropped out of the bracket, and a bit of wiggling got the thin ring that was the end of the spacer tube off the remains of the bolt. Less than five minutes, and no collateral damage to the bracket or anything else, it took me longer to get the spring and bottom plate off the U-bolts!

One bump-stop pedestal had completely rotted away, and the other was hanging on by a thread, so replacements needed for those as well as the front eye bolts. Reassembled everything with Waxoyl, turning to a clear liquid on what was a very warm day. As on the V8 with the front eyes mounted the rear shackles lined up with the chassis rail holes without compressing the spring, neither did the shackles lock under the chassis rail when I jacked up under the spring to fit the U-bolts and bottom plate. Again the U-bolts and plates were the biggest fiddle, getting them lined up, and getting the 'bump' in the top plate lined up with the hole in the bottom of the axle spring-pad. The factory anti-roll bar makes this slightly more difficult as you can't move the axle fore and aft directly, you have to rotate the whole axle to move the spring mounting pad into position over the spring. The second side is even worse as with the first side fitted you can't even do that, and a firm push from a foot on the brake drum was needed. One thing I noticed is that the new front bolts are only **just** long enough, and that is with the old nuts and lock-washers. Nylocs were supplied with the bolts but to be honest I don't think they were long enough to get the requisite minimum three threads clear, as it was the end of the bolt was just shy of the end of the nut. Other than that (well, there are only the shackles left!) it all went back together inside the hour, and that includes wheels on and tools etc, put back in the garage.

Herb Adler tackles the same problem.

Ride Height

Spring and rebound strap appearance with normal loads



There have always been intermittent complaints from North America that new springs sourced locally raise the rear way too much and sometimes are too stiff or arched to get the rebound straps or even the shackles installed without some serious extra weight in the boot/trunk. If you have to do that then at the very least the rear will be higher than it should and may even be fully extended instead of mid-way between the extremes of its travel which is obviously very wrong. With the vehicle on its wheels, even with nothing in the boot/trunk, the rebound strap should be curved round in an arc, the lever-arm damper arms approximately horizontal, the springs nearly flat, and the shackles around vertical or pointing slightly rearwards, as shown in the pictures on the left of this paragraph (click to enlarge). The rebound straps must **not** be straight and under tension.

Currently there seems to be a real spate of problems (but see this), and people in the UK are beginning to complain of the same thing. You **should** be able to fit the rebound straps by jacking each spring up under the body - without any extra weight in the boot - **before** the body starts lifting off its supports. On UK-sourced springs I have done this without difficulty, even putting the harder rubber-bumper springs on a chrome-bumper car. Similarly people have asked how to get the shackles pointing to the rear instead of the front. Again it is a matter of spring hardness - the correct springs should be almost flat with just the weight of the unladen body, and as they take the weight of the body and start to flatten they will move backwards. If the weight of the car is on its wheels, even unladen, and they aren't pointing slightly backwards, the springs you have are simply too hard or over-arched for your car. However it occurs to me that all the work I have done has been on a chrome-bumper car. With the lower shackle mounting position relative to the chassis rails of rubber-bumper cars it is possible that these can lock in the fully forward position unless levered downwards while jacking slightly higher. However once the rebound straps are fitted this shouldn't occur again. *Updated August 2007:* Since writing this I've had to replace the rear springs on the V8. Having now bought three sets of springs from three different suppliers and fitted them to two different cars I have never had any problems using simply the weight of the body to compress the springs enough to attach shackles, damper drop-links and rebound rubbers, and this includes fitting harder RB roadster springs to a CB roadster. Nor have I had any problems with the shackle 'locking up' in a forward position on either CB or RB car. See Rear Spring Replacement.

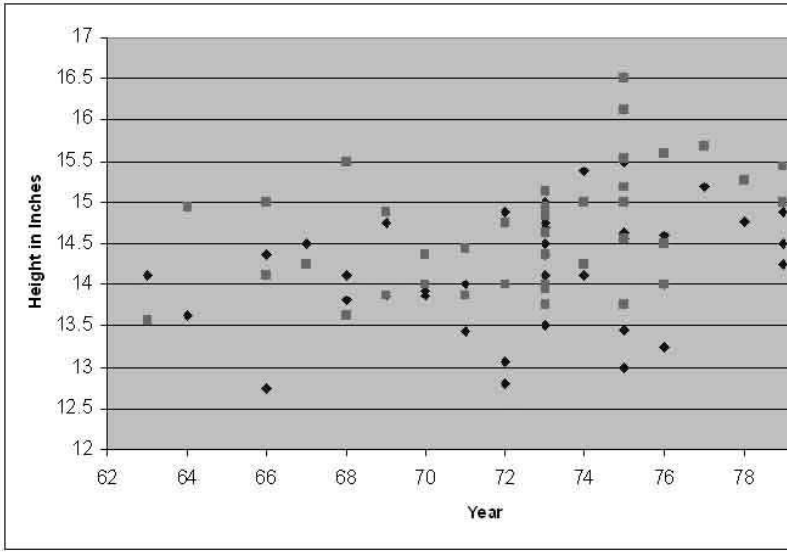
My problem has been the opposite - ride-height too low and grounding over 'sleeping policemen' and rough ground particularly when laden (we use the car frequently for holidays with a comprehensive tool kit and trolley-jack as well as luggage). I had tried and removed rubber-bumper roadster springs as part of another exercise which raised the ride height just fine, but being harder they gave a very unpleasant choppy rise over some surfaces. In July 2003 I modified some shackles by 'cutting and shutting' to give about an inch extra height at the rear, as described below in 'Extended Shackles'.

Ride Heights round the World

Following a question on the MG BBS the information on ride heights below was posted, all measurements are taken from the centre of the hub to the bottom of the chrome strip.

If you would like to add to this resource please mail me with your year (state CB or RB if 1974), Roadster/GT, measurements, and any notes regarding age/mileage of springs, departure from standard etc.

Note: It may seem obvious but the static ride height of a car depends on how much weight is on the suspension. Take the engine, gearbox and seats out for example and you remove a good quarter of the weight. The body will rise on the springs, probably to the limit of the rebound rubbers at the front and the rebound rubbers at the rear. On both my RB V8 and CB roadster this results in there being very close to 17.5" from the centre of the hubs to the bottom of the trim strips, front and rear.



Car	RHF	LHF	RHR	LHR	Owner	Notes
63 roadster	14.25	14	13 3/4	13.375	Rob van der Linden, Cambridgeshire	Original springs, 60k
64 Roadster	13.75	13.5	15.375	14.5	Mike Jones, Malaga, Spain	All new springs and bushings. First two sets of rears from MGOC were 2" too high, 3rd set MGOC got from British Springs.
66 Roadster	14.5	14.25	14.25	14	Bud	
66 Roadster (?)	12.75	12.75	15	15	Max Heim	Original Fronts, new rears, 175R-14 tyres.
67 GT	14.5	14.5	14.25	14.25	Barrie Parkinson	Rebuilt front end with V8 bushings, stock springs. Rear all new plastic bushings and fibreglass springs. No bumpers, alloy head, no spare, 1 battery.
68 GT	13.625	14	15.5	15.5	BobMunch, Boise	

68 GT	14.25	14	13.625	13.625	John Hubbard, Huntsville, Alabama	The fronts are up from 13.625 following a front-end rebuild. The wishbones and pivots were badly worn, see John's pics
69 Roadster	14	13.75	14.75	15	Tony Elphick, Wagga Wagga, Aus	Standard. Rears reset 15 months ago, fronts new
69 Roadster	14.5	15	13.5	14.25	Miguel Clemente	50k miles, all original except for front bushes.
70 Roadster	13.875	13.975	14.25	14.5	Joe Lucas, Winipeg, Canada	Stock all around except for new bushings front & back. Spare tire on board, single 12 volt battery in place.
70 Roadster	13.875	13.875	14	14	Peter Baker, UK	Heritage shell 20k, spare tire on board, single 12 volt battery in place.
71 GT	14	14	13.75	14	Bill, Montana	Front springs new, rears original with new bushes and pads. 200k+miles
71 GT	13.5	13.375	14.375	14.5	Bob Wilson	Fronts (red) 3k, rears (original?) 113k?
72 Roadster	12.8	12.8	10.24	10.24	Richard Thompson	These seem very low but are off Richards own site and converted from cm at 2.54cm to the inch.
72 Roadster	14.875	14.875	14.75	14.75	Iain MacKintosh	
72 Roadster	13.125	13	14	14	Stan, Bucks, UK	68k, fronts look original, rears have been replaced but look flat
73 Roadster	14.5	14.5	14.25	14.5	Paul Hunt, Solihull, UK	Original fronts (120k+miles?), new rears (20kmiles), new rear bushes
73 Roadster	14.25	14	15.125	15.125	Paul Hunt, Solihull, UK	RB Roadster front and rear, red poly bushes at rear, 10k miles
73 Roadster	15	14	15.375	14.313	Ken Earnhardt, USA	All worn suspension parts replaced. New rears fitted.
73 Roadster	14.875	14.5	14.875	15	Ken Earnhardt, USA	New fronts fitted to the above, at which time the RH rear was found to be too high, the spring having a greater arch. LH and RH rears swapped over. Updated figures after a little settling, 165SR-15 tyres in use.
73 GT	13.5	13.5	14	14	Paul Tegler	

73 Roadster	14.25	14.5	13.875	14	Richard Smith, USA	New Victoria British rears c1994, original fronts. Rears originally too high and at the limit of rebound straps, settled since. 185/70 x 14 tyres rub slightly on left-hand rear wing.
73 GT	14.75	14.75	14	13.5	Kerry Schofield	78k recently rebuilt by MG specialist
73 GT	15	15	15	14.25	Kerry Schofield	MGOC parabolics at the rear with GAZ dampers. At the front I have had Frontline castor wedges fitted and no other change. (4th Feb 2017)
74 GT	14.25	14	14.25	14.25	Steve Cioffi, Everett, Ma	Original springs, all new bushings and mountings
74 CB V8	15.5	15.25	15.25	14.75	Gordon, UK	LHR bush collapsed, replacement pending, possible mods
75 Roadster (?)	15.5	15.5	16.125	16.125	Bob Hacker, Vancouver, Washington	Stock springs, V8 bushes
75 GT V8	14.5	14.625	15.125	14	Paul Hunt, Solihull, UK	Original, LHD sag on a RHD!
75 GT V8	14.5	14.625	15.375	15.6875	Paul Hunt, Solihull, UK	New fronts and rears, 5k
75 GT V8	14.5	14.75	15.125	15.25	Colin, UK	Pretty standard apart from Koni dampers, springs probably original, 77k
75 Roadster	15.5	15.5	16.5	16.5	Dave Tetlow, Bucks UK	CB & V8 conversion, CB springs, still trying to reduce ride height
75 Roadster	13	13	13.75	13.75	Dave Tetlow, Bucks UK	As above, but now with 1" shortened V8 front springs, reverse-eye rear springs. Standard dampers with uprated valves, 15" MGC wheels with 185-65 tyres.
75 Roadster	13.3	13.6	15	15	John Tampkins	CB conversion, MGOC lowered front springs, chrome bumper (100lb/in) parabolics at the rear with all the shims above the springs.
76 Roadster	14.625	14.5625	15.625	15.5625	Barry Kindig, Escondido, CA	New springs all round, 1.25" lowering blocks at rear, 185R70 14 tyres
76 Roadster	13.25	13.25	14	14	John Leader, Austin, TX	Lowered fronts from BritTex, 2 1/2" lowered rears from Moss. Pirelli P6000 205/55 15 on Minilite. 28psi front, 31psi rear.
76	14	14	14.5	14.5	Mark Garret, UK	Lowered fronts, lowered parabolics on rear (all plates on top of springs), Spax all round.
77 Roadster	15.25	15.125	15.625	15.75	John, Brisbane Australia	
78 Roadster	14.56	14.96	14.96	15.55	Peter Bird	
79 Roadster	14.5	14.5	15	15	Martyn Harvey, Ontario Canada	V8 conversion, early GT fronts, de-arched GT rears.
79 Roadster	14.25	14.25	15	15	Mike Cook	V8 conversion, late GT fronts, lowering blocks on original rears, 79k miles.
79 Roadster	14.75	15	15.75	15.125	Lars-Erik Kallstrom	Front: Moss Road uprated springs AHT21, V8 bushes, 500 miles. Rears standard, 70k miles.

By-the-way. The V8 always had a higher ride height to compensate for its reduced ground clearance. At the front this was achieved by using a special cross-member, which eventually became the cross-member on all rubber-bumper cars, and at the rear by using lowered spring mounting points. Clausager states that the V8 ride height was not altered with the introduction of rubber bumpers. My rubber bumper V8 has lowered front **and** rear hangers for the rear springs, but I have it on good authority from Kelvin Dodd that a chrome bumper V8 he has seen definitely only had the lowered front hangers, the rear hangers were standard. Subsequently confirmed on two CB V8s I was able to inspect. If the rear hangers were altered for rubber bumper V8s, i.e. to make them the same as rubber bumper four-cylinder cars, then there would have been a change in V8 ride height. The rebound straps didn't change on the V8 with rubber bumpers which implies axle travel was the same, and the 4-cylinder cars adopted the V8 straps for rubber bumpers which implies they got the same suspension travel. However 4-cylinder cars seem to have used the same bump rubber pedestal all through, whereas the V8 originally had it's own pedestal for chrome bumper which changed to the 4-cylinder item for rubber bumpers, which implies a change in suspension travel between V8 chrome and rubber bumpers. Likewise the 4-cylinder seems to have kept the same damper drop link all through, whereas the V8 changed between chrome and rubber bumpers, both being different to the 4-cylinder item. V8 springs were always different and changed between chrome and rubber bumpers.

Converting RB to CB. *Added January 2008*
A number of factors to consider here:

- Standard CB springs on a standard RB shell will do very little as the mounting points for the rear springs are lower on RB cars than CB cars, and at the front the car sits higher on the cross-member. Special flattened or lowered springs must be used, or at the very least the rear modified by turning over one leaf, or replacing the main leaf with a reverse-eye one. You can fit lowering blocks between axle and spring and use longer U-bolts, but that increases the leverage on the bushes in cornering. Altering the rear spring mounts themselves in order to use standard CB springs is a major job, particularly the rear eyes.

- With flattened or lower springs if you do nothing else you will almost certainly 'bottom' the suspension over relatively minor bumps and humps. RB cars have a higher pedestal that sits on the axle under the bump-rubber, so the shorter CB item can be fitted instead to increase the compression travel. This now means the axle has greater travel under compression than before, which means you could hit the limit of movement of lever-arm dampers and damage them, so you must also fit CB drop-arms which are shorter. But then that means you run the risk of hitting the damper limit when the axle is extended, so you must fit CB rebound straps as well.
- But if you fit lowering blocks between axle and springs you must use the original damper drop-links as you haven't changed the relationship between the body and the springs and hence the bottom plate the drop-link attaches to, just the body and the axle. This will still need the lower CB bump-stop pedestals and the shorter rebound straps as before as they are both on the axle.
- And after all that, as Kevin Jackson has pointed out, you now run the risk of grounding the exhaust, as it is angled to sit lower to clear the lower axle position of the RB car!
- Kevin also pointed out one benefit of achieving a lower ride height through flatter springs and that is less leverage on the bushes and so probably better axle location, i.e. the opposite of lowering blocks.

Extended Shackles

The roadster had always looked low at the rear to my eyes, and the springs were almost flat even when unladen, so I thought they were worn out. Fitted a pair of new OE items and was surprised to find that they made very little difference. As we use the car frequently for trips away from home laden with a comprehensive toolkit and trolley jack as well as luggage, speed-bumps and uneven ground were a real problem, with frequent grounding of the exhaust. I had also never been able to change a wheel by jacking under the axle as the tyre was too far up inside the arch and always had to jack under the front mounting, which means lifting the car quite a long way before the tyre cleared the ground. However this was minor compared to the Navigator's wincing when grounding.

In July 2003 I decided I had to do something about it. I did have rubber bumper roadster springs on for a while (part of another exercise) and whilst these gave me the extra height they were also harder and gave a choppy and unpleasant ride over some surfaces and eventually the proper springs went back on. I considered re-arching these springs but felt that would be a bit hit and miss. The alternative was longer shackles. I was surprised to find that rubber bumper and chrome bumper cars used the same shackles. Seeing as how the front eye is only about an inch or so lower, but the car is 1 1/2" higher, the extra must come from extra spring hardness and/or arching and this does seem to be the case on my RB V8. I did find some adjustable shackles but they are very expensive, more than I was prepared to spend. A few enquiries elicited no other sources of longer shackles, other than paying an engineering shop to produce some, or modifying standard ones myself.

The very expensive adjustable shackles mentioned above have three pairs of holes for the bottom pin, which is just a long bolt going through both plates. The originals have the pins pressed into splined holes in the shackle plate and the pins have a double shoulder at the threaded end, the smaller of which fits into the hole in the closing plate. This keeps the threads away from the side of the hole so protecting them, but more importantly makes the tightened shackle a rigid parallelogram, aiding spring and hence axle location. Plain bolts will allow the rectangle of the closed shackle to be distorted into a rhomboid during cornering, which will give more lateral movement of the spring and hence the axle. Over time this will tend to make the holes in the plates oval and wear grooves in the bolts so weakening them. There is also the issue of tightening the shackles. Even when the original shackle is tightened to 30 lb.ft. the bushes are only

lightly nipped and there is clearance for the spring eye to pivot on them. But without some form of spacer tube a plain bolt is going to tighten the shackles onto the bushes and spring eye, restricting movement, and probably damaging the bushes in a short time.

I decided to modify some myself. But rather than cut up and weld a piece into my existing ones I bought two pairs of the standard items and used those. This was for two reasons - I wanted a 'proper' set to go back to if I needed to, and I wanted only one weld in each rather than two. In the event it was an easy enough job and if I were doing it again I would extend the existing pair with two welds and a piece of flat bar and save myself £40.

The first job was to decide how long - the distance between the centres of the shackle pins - I wanted them to be. The standard items are 2.5", I wanted about an extra inch as measured between the hub centre and the bottom of the chrome strip, and given the various angles and lengths of parts I reckoned on about 1.25" longer at the shackle, i.e. 3.75" in total. I didn't want to guess and get it wrong but be a bit more scientific, so I made up two wooden blocks to go between the spring eyes and the chassis rails, shackles removed, then added and removed further wooden 'shims' until I got my 1" extra between hub and trim. This was a bit of a fiddle, jacking and lowering the spring and axle, but fortunately I got it right on the second go. I then measured the distance between the centres of the holes in the chassis rail and spring eye, and it turned out to be 3.75". Oh well, at least I knew it was going to be right.

At this point a word about removing the springs. I say 'removing' but I didn't actually remove them altogether, the front bolt was all that was left so the following process is good for complete removal too:

- Jack under the axle to raise the back of the car off the ground and securely support the body under the rear spring front mounting point reinforcing plates, high enough so that the wheels are off the ground when the jack is removed.
- Lower the axle so it is suspended on the rebound straps, or, if your straps are broken or suspect don't go any lower than good rebound straps would allow to avoid stressing the dampers or rear brake flex hose, and support the axle near the bottom of its travel on axle stands. Now would be a good time to replace bad rebound straps!
- Now jack under the spring itself, close to the U-bolts. Raise it a couple of inches or so but not so much as to start lifting the body off its supports.
- Remove the four U-bolt nuts, pull the damper mounting plate and spring locating plate down off the U-bolts and push them towards the front of the car so that they are under the front half of the spring. If you raised the spring and axle high enough above this is easily accomplished in the normal downward travel of the damper.
- Jack the spring down, it will clear the U-bolts, and keep going until all tension is released, pushing the damper mounting plate further forward if required.
- Remove the rear shackle. With no tension in the spring you should be able to wiggle it about to get it free once the closing plate is off. If the rubber bushes are damaged or perished change them.
- Removing the front mounting bolt now will allow complete removal of the spring, if required. Take care, they are surprisingly heavy! If the drivers side has sagged more than the passengers swapping over the springs will restore an element of balance when the car is occupied.

By putting wooden blocks between the spring rear eyes and chassis rails and varying the thickness of the blocks with shims, supporting the springs under the axle on jacks and lowering the car till the tyres just touch the ground, you can get a reasonably accurate measurement of the distance between the centre of the hub and the bottom of the trim strip as it will be in normal use. The distance between the centres of the holes on the

spring and chassis rail then determines the required shackle length. With a pair of dial calipers I used the outside jaws to measure the distance between the closest part of the two holes, then used the inside jaws to measure the furthest part, halved the difference and added that to the lowest figure to get the centres.

By cutting and shutting two pairs of shackles, as I was, you then have to determine where to make the cut. I felt it best to make each half the same length, which meant half of 3.75" i.e. 1.875" from the centre of one of the pins. Careful measuring, scribing and cutting produced the pieces as shown in the picture on the left (click to enlarge). As well as the pieces from four shackles which are going to be welded together to produce two, you can also see an example of the discarded parts of each shackle. 3/75" is just inside the flat part of the shackle plates, much more and you would be cutting across the dished part (which is no big deal but it would look a bit odd when welded together), and you only have about 0.25" available anyway before you reach the pin. Don't weld half of a closing plate to half of a pin plate as I have the top ones laid out! I didn't, but only noticed I had them laid out incorrectly when viewing the picture when I came to write this account.

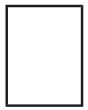
I wanted to grind the welds flat after fabrication, so to get maximum strength from the weld I ground both sides of each cut edge at an approximate 45% angle to make a 'V' groove each side when the pieces were put together, as shown in this picture. Not terribly clear, but you should be able to make them out.

Next came the job of welding them together. I decided to do the shackle plates before the closing plates as I considered the former easier to get aligned with reference to each other, then the closing plates can be aligned with reference to the welded shackle plate. The shackle plates need to be aligned such that the pins are parallel in two dimensions - one so that the centres of the pins are the same distance apart for the whole of their length, and the other so that the two pins are at the same angle when viewed one behind the other. Finally the two halves of the shackle plate should be as level and flat as the previous two alignment criteria allow. I opted for holding them lightly in a vice across their width, tapping first one then the other until all three criteria were met, then tightening the vice and making sure they were still correctly aligned. Because I was welding two halves of different shackles together they were of slightly different widths which meant that when one was tight in the vice the other was still loose, so I used some thick card as 'soft jaws' which deformed and gripped each half with relatively equal force. I MIG welded one side filling the 'V', checked the alignment again, then turned them over and welded the other side filling the other 'V'.

The closing plates are less critical, only having to get them flat and level, and using the completed shackle plates to ensure that the holes are at the correct centres. The welded and ground parts can be seen here.

All that remains is to fit them. With the U-bolts undone and the spring tension released you should be able to insert the shackles and bushes into the spring eye and chassis rail quite easily. Because they are longer than the originals and because the spring may be resting on the previously removed damper locating plate in its forward position, you may have to pull the rear end of the spring down a little against its tension in order to get the shackle in. You may also need a little Waxoyl or washing-up liquid on the bushes to act as a lubricant to aid insertion. Don't use oil or grease as it will rot rubber. Fit the closing plate, spring-washers and nuts. When tightening the nuts they may

tighten up before the shoulder on the pin has located itself into the hole in the shackle plate, then come looser as they locate properly, before finally tightening up to 30 lb.ft.



Jack the spring up under the axle, fit the spring locating plate and damper mounting plate onto the U-bolts, and fit and tighten the U-bolt nuts. The Workshop Manual shows double-nuts which can be locked together, but Nyloc nuts seem to be fairly common these days. Some say Nyloc nuts should only be used once, but I have seen a reference in a manual that says as long as you can't turn them with your fingers they are fine to reuse. If in doubt replace them. All that remains is to jack under the axle so you can remove the body supports, lower the wheels to the ground, and measure your new ride height after a short drive to settle things. After a longer drive recheck the tightness of the shackle and U-bolt nuts. The fitted shackles can be seen here, pointing slightly to the rear, and not far off right-angles to the spring which is nearly flat.

The before and after relationship between tyre and arch can be seen here, the white line is to emphasise the bottom of the arch. The 'before' picture (left) was taken at an earlier date (I forgot to take one immediately before changing the shackles) but both are taken under similar loadings.

A comparison of 'today' (February 2017) with when first modified, after some 14 years and 25k miles.

Spring Specs *Updated October 2008*

Front:

Car	Free Height	Spring Dia	Free Coils	Loaded Height	Load Weight	Rate lb/in	OE Part No.
Pre-72 Roadster	9.9	3.238	7.5	7	1030	348	AHH 6451
Pre-72 GT	9.1	3.28	7.2	6.6	1193	480	AHH 5789
72 Roadster	10.2	n/a	7.5	7.24	1030	348	n/a
72-on CB GT	9.32	n/a	7.2	6.84	1193	480	BHH 1077
73-on Roadster	10.2	n/a	9	7.44	1030	373	BHH 1225
RB GT	10.2	n/a	9	7.44	1030	373	BHH 1225
V8 (all)	9.32	n/a	7.2	6.84	1193	480	BHH 1077
Competition lowered	8.63	n/a	n/a	6.14	1193	480	C-AHT 21

Notes:
1. Information from Clausager, Factory WorkShop Manual, Factory Parts Catalogue, Special Tuning Manual, and Haynes.
2. The 73-on Roadster, CB and RB, and RB GT all had the same front springs as indicated above.

3. 'Loaded Height' is at the specified 'Load Weight' i.e. partially compressed. The difference between the free height and loaded height is the deflection, or the working load divided by the rate.
4. Clausager refers to the 1972 change as a 1/2" increase to all models to prevent excessive settling on export models when lashed down on ships decks for long periods, however the workshop manual shows a change of about 1/4" at that time.
5. Clausager makes reference to what he calls a 'Part number change only' in November 1972. However the Workshop Manual has three sets of specs for the CB roadster - I have assumed (maybe wrongly) that the third set is in fact the November 72 set that Clausager mentions. I have called these '1973 Roadster'. Dave Wood states he received a recall notice for his 72B later that year for a spring change to raise the height by 1/4" to meet minimum headlight heights which would seem to concur with the workshop manual. The Parts manual only has two part numbers covering the change early in 72, not the change in November 72.

Rear:

Car	Leaves	Interleaving	Width	Gauge	Load (flat)	Rate lb/in	Deflection in	OE Part No.
CB Roadster to May 63	5 + bottom plate	None	1 3/4"	0.2187in	400lb	99	4.04	AHH 6453 (GSV 1006)
CB Roadster May 63 on	5 + bottom plate	1/2 2/3 3/4	1 3/4"	3@0.2187in, 3@0.1875in	450lb	93	4.97	AHH 7080 (GSV 1006)
CB GT	6 + bottom plate	1/2 2/3	1 1/4"	3@0.2187in, 3@0.1875in	510lb - 540lb	99	3.2	AHC 31
RB Roadster to Sep 75	6 + bottom plate	1/2 2/3	1 3/4"	3@0.2187in, 3@0.1875in	510lb - 540lb	99	3.2	AHC 31
RB GT	6 + bottom plate	1/2 2/3	1 3/4"	3@0.2187in, 3@0.1875in	510lb	n/a	n/a	BHH 1767
RB Roadster Sep 75 on	5 + bottom plate	n/a	n/a	n/a	n/a	n/a	n/a	BHH 1779
CB V8	6 + bottom plate	1/2, 2/3, 3/4, 4/5	1 3/4"	3@0.2187", 3@0.1875"	550lb	n/a	n/a	BHH 1133
RB V8	6 + bottom plate	1/2, 2/3, 3/4, 4/5	1 3/4"	3@0.2187", 3@0.1875"	550lb	n/a	n/a	BHH 1771
Competition	n/a	n/a	n/a	n/a	375	100	3.75	C-AHH 8343
Competition	n/a	n/a	n/a	n/a	542	124	4.37	AHH 7346

Competition (lowered AHH 7346)	n/a	n/a	n/a	n/a	542	124	3.37	C-AHT 20

Notes:
1. Information from Clausager, Factory WorkShop Manual, Factory Parts Catalogue, Special Tuning Manual, and Haynes.
2. Although the roadster originally is described as having five leaves and a bottom plate ('six leaves' elsewhere) and the GT is described as having six leaves and a bottom plate ('seven leaves' elsewhere) both the 63-on CB roadster and various GT springs are described as having 3 leaves of each thickness. This seems contradictory, and the roadster did get shorter U-bolts when it reverted to the previous number of leaves in September 1975.
3. These springs are listed - without prices - by GB Springs as 'Heritage Car Springs', with some variations from the original part numbers. Some of these seem to be where the spec was changed for a particular model, only the later spec is now supplied, for example only one CB roadster spring is listed whereas until May 1963 a different spring was used. Also they don't list a CB GT spring but it was the same one used for early RB roadsters i.e. AHC 31.

Unloaded Rear Spring Dimensions

A question about this was asked on the BBS and as I still have the relatively new rubber -bumper items I posted the following as a guide:

A	eye centre to eye centre	41 1/4"
B	inverted height from floor to top of top spring	8 5/8"
C	front eye centre to pin top centre	19 1/8"

See also the picture on the right of the table.

Remember these are relatively new rubber-bumper roadster springs, but all others should be close. If your dimension A is significantly less and B is significantly more then over-arching is the problem. If the dimensions are close but you still cannot compress them enough during installation, or the resultant ride-height is much too high, then the leaves are much too hard. In either case get your money back and source them from a reputable supplier in the UK.

Update January 2013: By now it's probably best to leave off the 'in the UK' as people here are getting duff springs as well. But Mark Bates in the US had the 'submissive monkey' stance, the rebound rubbers were pulled taut and snapped while parked. He removed them and found that dimension B - the arch - was fully an inch and a half more than mine. He purchased another set from The B Hive in America and they do have very similar unloaded dimensions to mine.

See also Front and Rear Suspension Considerations from Doug Jackson's British Automotive site.

Steering Lock *December 2014*

When Bee came to me there was only one ignition key, so I had a spare cut. It worked, but over the years as the lock has worn on the rare times I use it I have found that it is very difficult to turn the lock all the way back and remove the key as normal. This earlier 'front-entry' lock needs a twist-push-twist-pull to turn the accessories off and remove the key, but

this key wouldn't do that, it would come out too soon. As well as leaving the ignition switch then capable of being operated with a screwdriver, I cannot get the 'good' key in, so have to persevere with the 'spare' key - which fortunately does go back in, wiggling and turning gently until finally the lock does fully return, the key comes out as it should, and the 'good' key then works again. OK, so don't use the spare key, and get another one cut and hope that would work. Well the 'good' key is itself a copy and not original to the car or even of the same type, so what with that and 40 years of use on the original lock I decided to replace the lock now rather than wait until it properly jams, which is almost bound to be at an inconvenient time.

The original lock is quoted as being BHA 5215 (chrome bumper Feb 72 on), with BMK 2259 being a universal replacement for that and the earlier 13K 4180 (Mk1), 13H 4862 (Mk2 to Oct 69), and BHA 5209 (Sep 69 to Jan 72), the different part numbers relating to different manufacturers more than anything else. For completeness BHM 7056 was the side-entry 18G 8905 used on V8s and various North American spec cars, which has a push-button to release the key which is easier to use. Googling BHA5215 showed loads of suppliers, ranging in price from £59 to (gulp) £107. The good news was that I wanted to get mine from Leacy's as part of a shopping list it was worth going to collect and they were the cheapest. The bad news was they were out of stock! As the Irish shopkeeper said, "Well when we don't have them in stock ours are cheap too". So I looked up BMK2259 at Leacy's, the good news being they were in stock, the bad news being they were (even bigger gulp) £154! So I rang them, and apparently those part numbers include the ignition switch, and it was the switches that were unavailable for the BHA 5215 version. They have the bare locks listed separately as BHA5215X, but only on their stock system, not on the website. So he looked up those, the good news was they had them in stock, and the even better news was that minus the switch they are only £43!

These locks have special shear-bolts clamping them to the column. They may still have the heads attached which may seem odd. Many years ago I queried the fact that on my Mum's new Mini they still had the heads, and shouldn't they have sheared off when being tightened? Apparently not, they are supposed to shear if anyone attempts to undo them. However the heads were missing from Bee's. I was thinking that I would have to remove the steering column as I didn't want to use an angle-grinder in the cabin. But having a look I could see that the bolts are angled downwards and to the drivers side of the car, so conveniently placed for drilling along the length of the threaded part. Furthermore the shanks of the bolts stopped about 1/4" short of the hole they were in, which makes a useful drill guide, so drill in-situ it was. However! The first thing I had done was to test both keys operated the new lock and the bolt smoothly, don't want to wreck the old lock then find the new one doesn't work.

I needed to move the indicator stalk sub-harness out of the way, and unplugging it from the main harness seemed easier than removing the cowl and the switch from the column. However the black rubber moulded plugs and sockets stick together quite well and it was difficult to get a good grip on both halves. Then I had the idea of using external circlip pliers to lever the two halves apart, which took about one second!

With that out of the way I decided to remove the switch from the back of the old lock, so that vibration etc. from drilling didn't damage it. There is a small screw going downwards at an angle from the drivers side, through the body of the lock and into the switch. A little fiddly to get at, I used a hex drive screwdriver point in a very small ratchet. It's small, don't lose it. With that out I eased the rubber boot off the lock and the switch came away. I then offered up the switch to the new lock - there is a key and key-way that has to be aligned - and checked that

with the battery cut-off switch back on the accessories, ignition and cranking all worked. Again you wouldn't want to complete the installation to find it didn't.

I decided to use a 4 or 5mm drill to start with, even though the threaded hole is about 6 or 7mm, as a smaller drill goes through easier, then its hole acts as a guide for the larger drill. Drilled first one screw then the other with the small then the large drills until going by the depth I reckoned I was just past the join of the two halves that were clamped around the column. By now the lock was moving back and fore slightly round the column, tried levering against the column tube with a pry-bar, but not too hard. Drilled some more until I was sure the large drill was fully past the join, levered again and it fell off. It really didn't take me much more than an hour. I had managed to drill right up the middle of one bolt, and only slightly off to one side of the other.

Nothing more to do except position the new lock - which is a Lowe and Fletcher just like the original - onto the column, and do up the bolts no more than finger-tight as again I didn't want to complete the installation i.e. fully tighten them until I was sure everything worked. The clamp part has an offset hole, which seems to go to one end of the lock.

Fitted the switch into the back of the lock and inserted the screw ... and the switch came back out again. Had a couple of goes, but it still wouldn't go into the matching hole in the switch body, and I was beginning to think that the alignment was wrong. But with the screw going in partly from above with all the wiring there it wasn't that easy to hold the switch into the lock with one hand while positioning and turning the screw with the other. So I slackened the lock clamp bolts sufficiently for the lock to hang down which put the screw at a much more convenient horizontal angle, and it went straight in. Again tested the operation of the switch with both keys and all was well, so repositioned the lock and did the bolts up finger tight again. This time I turned the column, keys out, so that the bolt engaged and locked the steering, then waggling the wheel to take the load off the bolt check the keys retracted it, again all good. So final tightening of the bolts, and find the bolt heads are 13mm. They are also at an angle, so whilst one is easily accessible from below, the other is virtually on top of the column. Fortunately I have a set of swivel-head combination metric ratchet-ring spanners, and the 13mm one does the job. Not enough leverage to shear the top one, which I wouldn't attempt with the ratchet ring anyway, and although I could get a standard socket on the lower one I just do them up 'tight' but not too tight. I'll leave them like that for the time being to check all is well, with a view to increasing the tightness later on.

Steering Column *Added January 2010*

Types: *Updated September 2013* Not an optional gearchange in a different location, but which cars had what column (and wheel) when. According to Clausager four different types of column and wheel hub splines were used over the years, and are not interchangeable. However he gives the four types as 62 to 67, 67 to 69, 70 to 76, and 77 on - model years where appropriate. The Parts Catalogue doesn't entirely bear that out, but it has its own gap in the information. There are two sections for 4-cylinder columns and wheels - one described as 'Not North America or V8' and the other as 'North America collapsible type'. However Clausager states that the North American collapsible type wasn't used until the Mk2 of 1967, which if correct and because there are no parts listed for North America **before** it got the

collapsible column, indicates that all models used the same types for the Mk1, and that is what I have assumed. The Parts Catalogue is also quite clear that the same spoked wheel and columns were used in non-North American markets until the start of the 1970 model year. So whilst North America used one type for the Mk1, and another type until the start of the 1970 model year, other markets used the same type from the start of production to the start of the 1970 model year.

Originally the column was solid i.e. non-collapsible and did not have a steering lock and ignition switch. RHD and LHD for all markets used the same components which consisted of a separate inner and outer. Various non-North American countries got steering locks at different times between 1962 and late 69, and hence had different inners and outers, which also differed between RHD and LHD. These used wire-spoke wheel AHH 9284 which was used until 1970. In 1967 North America got a collapsible column for the Mk2, with what Clausager describes as 'an easily defeatable' steering lock. Still with the wire-spoked wheel, although this wheel has a different part number AHH 9825, implying it was different to the non-North American parts. To my way of thinking this makes all markets for the Mk1, and non-North American to the start of the 1970 model year using the first variant, and North America Mk2 to the start of the 1970 model year using the second variant. *June 2015:* Note that the solid column slides freely in the tube and if removing and refitting or replacing the column as a whole you may have to adjust the position of the outer in its clamp brackets, i.e. slide it up or down relative to the inner, to get the indicator switch and horn brush in the correct position relative to the cancelling peg and horn slip-ring. The position of the inner is determined by the U-joint and rack.

In 1970 non-North American inners and outers changed. There were still locking and non-locking variants, and hence RHD and LHD locking variants. North America got a different column with improved, side-entry lock. From 1st January 1971 the UK required a steering lock, so a column with a front-entry lock was fitted to cars for all markets except North America. For the 1972 model year in non-North American markets the column changed to a collapsible assembly rather than separate tubes and shafts. The wheel for all markets had alloy spokes with five holes in each from 70 to 72, changing to slots for the 73 model year, but only a few months later the slots were changed to depressions. V8s had the side-entry lock on a different column, and the wheel with depressions for the whole of production. From the start of rubber bumper production all cars including the V8 and regardless of market, got the same full energy-absorbing column (crushable outer as well as collapsing shaft) with side entry lock. The components then remained unchanged until the end of the 76 model year. As the wheels and columns have different change points, and the Parts Catalogue indicates the wheels were common to all markets, V8 and 4-cylinder, they must have been compatible, so this is the third variant - 1970 to 1976. I've been able to compare a 73 roadster and a 75 V8, and whilst the wheels fit on each others splines the taper seems to be slightly different, even though the change-points indicate they should be the same. With the 'right' wheel pushing the wheel down onto the taper locks it, whereas with the 'wrong' wheel even pushed down it wobbles from side to side very slightly. However once locked with the nut I'm pretty sure there would be no problem. 1975 Jubilee GTs may have had an all-black wheel with a gold MG horn-push logo. Other cars built during the 1975 Jubilee year had the metal-finish spokes with the gold logo.

For the 77 model year the column and wheel (now with four rubber-covered spokes) changed, again common to all markets, giving the fourth variant - 1977 on. However this is more to do with completely different arrangements for cancelling the indicators and sounding the horn, the splines and threads appear to be the same. The MG logo was originally dark grey, then silver as standard. UK 1980 LE models had the standard wheel but with a red MG logo. North American Limited Edition models of 79 and 80 had a wheel similar to the 70 to 72 but with three holes instead of five.

October 2013:
I have found the following list concerning North American cars which agrees with the change -points above:

Years	Splines	Thread	Socket
62-67	3/4" by 48	11/16" X 27 TPI	1 5/16" or 34mm
68-69	5/8" by 36	9/16" X 27 TPI	1 1/16" or 27mm (to be confirmed)
70-76	11/16" by 36	9/16" X 18 TPI	1 1/16" or 27mm
77-80	11/16" by 36	9/16" X 18 TPI	1 1/16" or 27mm

However markets other than North America probably continued with Type-1 until 1970 and so only have three types. Note also that Type-3 and Type-4 and identical, but the steering wheels for all markets changed in 1977 to one with the indicator cancelling arrangement integral to the wheel, instead of using the cam on the column. So whilst the steering wheels are interchangeable on the column, the Type 3 wheel will not cancel the indicators on a Type-4 column and switch-gear.

Interestingly the 'collapsible' columns before the full energy-absorbing allow the shaft to move freely up and down within the inner. So in any frontal impact an unbelted occupant could push the wheel forwards, collapsing the inner and crushing the switchgear, allowing more travel before hitting something solid but little energy absorption i.e. deceleration. If the collision is so severe as to move the rack rearwards the steering wheel and inner shaft would actually move towards the occupant, possibly allowing even a belted driver to hit it, although that would collapse the inner shaft. The later full energy-absorbing columns are different in that the inner cannot move in and out of the outer. An unbelted driver will probably suffer greater injury from this type of column as the wheel cannot be pushed forwards until there is sufficient force (from the driver!) to deform the structure the column is bolted to. If the rack moves backwards then the inner will shear with very little force, and no energy absorption as before. It's only if the toe-board comes back far enough to hit the bottom of the column outer that the mesh construction of the outer will do its energy-absorbing stuff, and prevent the wheel moving towards the driver. But it's difficult to see how that could happen, except possibly in a V8 where the engine moves backwards. If the impact is severe enough to deform the toe-board, even with a V8, it's difficult to see how the energy absorbing column is going to make much difference to the injuries of the driver, given that this 130kph/75G impact of an MGB with a solid concrete wall resulted in no intrusion into the cabin.

Indicator/turn Switch, Cancelling Striker and Cowl Positioning *August 2015:*

If fitting or replacing a column on chrome bumper cars i.e. without the full energy-absorbing column (i.e. not V8s, and North America may have got them earlier than the UK) the column outer has to be positioned correctly for the indicator/turn switch and cowl. Note that the position of the inner and hence the steering wheel on all cars, and the cancelling striker on Mk1 cars, is determined by the column and rack assembly being bolted to the front cross-member. The column outer is supported by two U-clamps in brackets, one under the edge of the dash and the other under the heater shelf. To adjust the position of the column outer slacken both these and slide the outer up and down to suit. Correct positioning depends on whether you have a Mk1 or a Mk2:

- On Mk1 models the cancelling striker position is fixed, but there is a small amount of variability in the position of the switch on the outer. Position that centrally within it's range of movement, then clamp the outer such that the switch fingers are correctly aligned with the cancelling striker.
- On Mk2 models the switch goes in a fixed position on the outer, set by a 'lump' on the switch body that sits in a cut-out in the tube, and there is a large range of adjustment in the position of the cancelling striker on the column inner. In this case the column outer

position is determined by the relationship between the column cowl and the back of the wheel. The cowl has a flange that should fit neatly inside the back of the wheel, but not so far that the back of the wheel rubs on the base of the flange. With that set correctly, adjust the position of the cancelling striker to suit the position of the switch fingers. At the base of the column outer there should be a concertina tube to seal the hole in the bulkhead, over a range of column outer positions.

Note that even slackening these clamps may well disturb the column and rack UJ alignment, which should be checked afterwards.

With the later full energy-absorbing column the relationship between inner and outer and hence the switch, striker, steering wheel and cowl are all fixed within the column.

Repair to a Collapsible Column: This account relates to the later full energy-absorbing column, with (apparently) three bolts securing the lower end to the toe-board.

Vee's steering wheel has always had a bit of rotational play in the column. At about 6-7mm it is a good bit less than the UK MOT limit of 13mm (and a whole lot less than the 30mm specified in my Toyota Celica manual!) but I still didn't like it, for one thing it rattles over some surfaces. As well as the rotational play the steering lock has never worked in my ownership, so I was wondering if I would be able to do anything about that. The car also had a pump short before my time (as has Bee and two other cars I have worked on, all with fuses now!) so the brown and white were damaged. The white only very slightly there (much worse elsewhere) but the brown has had the bullet connector for the switch harness cut out altogether and the wires spliced together. It's had various electrical bits added before my time also connected to this splice, and when I added a horn relay I added one more to it (at least mine was brown). I'd also had an alarm installed, and the fitter soldered his wires to the 12v and indicator wires on the switch side of the multi-plugs (easier to get at) so with the repairs and additions it was all a bit of a mess round the column - another opportunity.

First job was to remove the upper UJ clamping bolt, so the column shaft can be pulled out leaving the UJ behind. It's worth mentioning here that although my roadster has just a notch on the column shaft, and a groove running all the way round the rack shaft meaning the two shafts can be reassembled in any orientation which seems to be the norm, both the V8 shafts only have notches, so the UJ can only be installed in one position on **both** shafts - strange, but true. Loosen the other bolt right off while there is still some support from the other shaft, but leave the bolt in position so the UJ stays on the rack shaft, and the nut on the bolt a few threads so the bolt doesn't fall out!

Steering wheel comes off with the usual method. This makes it much easier to get the two halves of the cowl off, especially as the additional screws at the bottom, handily (not!) covered by the dashboard, were removed and not refitted by a PO. This is why the book says to remove the column complete with cowl and switches, which would be right pain if all you wanted to do was adjust the horn brush! In fact the book says to remove the column complete with the steering wheel as well as the cowls and switches, which is stupid if you subsequently need to remove the wheel. Unscrewed the column switches and left them dangling. At that time I couldn't see how to remove the ignition switch from the steering lock so had to cut the splice in the brown, and the alarm wire. The other ignition switch wires are on bullets, rather than a multi-plug like the column switches.

When it came to undoing the three toe-board bolts they were only finger-tight, and when I got them all out (the top one is tricky, needing two 3/8" wobble extensions) the plate wasn't attached to the column anyway, not just loose but flopping all over the place and falling right off when I finally removed the column! The hole in the plate is quite a bit bigger than the end of the outer tube it fits over, so there is no way it can align the bottom of the column to the

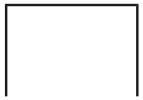
UJ, which some say it does, but more of that later, the upshot is that simply slackening the three toe-board bolts should be all that is required to pull the column out, and leave the plate and rubber seal in-situ - much easier than completely removing all three bolts.

When I undid the upper bolts and started trying to pull the column out I could tell the lower half of the inner was staying where it was, even though I had removed the UJ bolt. I realised I would have to lever it out from inside the engine compartment so would need to support the wheel end of the column on some cord while I did so - of course no cord within reach! So I tried to put one of the upper bolts back in but even though the column bracket is slotted it was too far back to get any bolts in. Took quite a bit of pressure pushing the column down towards the toe-board against what seemed like spring pressure to get one in. When I finally got the column out of the car I found I could pull the bottom half completely out as the shear pins (actually injection moulded plastic) had done just that - hence the rotational play.

There is a spring at the bottom of the lower half, pressing back against the lower bush in the outer, and forwards against a circlip on the inner shaft, which is effectively trying to push the shaft out of the bottom of the outer all the time. Ordinarily the shear pins mean it is pulling on the upper half of the shaft, and the upper bearing on that is pulled down into the upper end of the column, as well as being retained by another circlip. That's why I had trouble temporarily getting an upper bolt back in - I was having to compress that spring by pushing the column towards the toe-board far enough to get an upper bolt in, and it's quite a hefty spring! As to when and how the pins had sheared, I don't know.

With the column finally out there is a plastic sleeve wrapped round the lower half of the column, covering the collapsible mesh section. Glued or heat-bonded with five blobs down the edge I cut through the bonds with a sharp knife, and can now see the shaft through the mesh. With the lower half of the shaft pulled out I can see the remains of the injection moulding process in two places on the upper/inner half of the shaft, and four 'nubs' of plastic sticking out of four holes (two each side) in the lower/outer part. I also find that with the lower half of the shaft out, the free end of the upper half is free to flap about inside, and in some positions the steering lock (key out) is catching, but when held centrally it is free. So I wonder if it has been attacked by thieves before my time (apparently if you don't turn the wheel to engage the lock when you have removed the key, they can wrench the wheel round and as the locking pin drops into the hole the momentum snaps it off). But later on when I have been working on the column I find the lock engaging with both parts fitted, and has to be released with the key, so maybe the locking pin is whole but just sticky. I do find the ignition switch slathered in oil, maybe squirted in to try and get the lock working. **Never** use oil or grease in a lock, only graphite powder.

With the column on the bench I espy a tiny grub-screw under the switch, which when unscrewed to flush with the lock housing allows the switch to be withdrawn. If you are going to be leave the switch out for any length of time screw this back in to prevent it falling out and getting lost. One oddity with the ignition switch is that with the various work that has been done on the wiring there is black insulation tape wrapped round it, which I have to remove to expose the alarm wire soldered to the brown, and I find a purple/pink wire. Now this is only used on North American spec cars, for the anti-runon valve. So whether the car has had an American column and/or switch at some time, or whether the manufacturers use a standard tail and just cut the unused wires off (there is no spare contact on the switch for this wire) I don't know.



I don't want to cut the lock assembly off the column (the shear bolts have sheared off), so wonder if I can remove the upper half of the shaft from the outer. This may allow me to see what is happening with the column lock, and possibly free it up if it isn't broken. I espy a circlip quite deep inside top of

the outer, and manage to get that out of its slot. My angled internal circlip pliers won't go in that far, but by using one leg of a straight external set to lift up one end, I can then get one leg of my angled internal pair in that, and shift the other end of the circlip with one leg of my external pair. The shaft with it's bearing can then move up and down a couple of inches, but something is stopping it coming out altogether. There is an alloy casting at the top of the tube, held on with three large pop-rivets. I'm guessing I could have drilled those out, and the casting would have come out allowing the upper bush and shaft out, but don't have any replacements that size so stop short of drilling them out. Oh well, it's not had a steering lock for my 16 years, I doubt it matters now. *December 2014:* It was only after replacing the steering lock on Bee that I suddenly thought that it was probably the steering lock that was holding the shaft in the outer, if I had inserted and turned the key it might have come free. However when responding to a BBS request about stripping these columns I mentioned that, but he had the same problem and didn't even have his lock fitted. *end of update* Incidentally, the fact that the upper part of the shaft is retained in the outer this way, means that hammering on the end of the column to free the steering wheel, especially if your knees are braced behind the wheel, means that you are highly unlikely to break the shear pins, much less collapse the column. It's more likely to be a problem at the other end if you have to hammer or lever the UJ back on if the splines are stiff, but even then there is a strong spring pressing the lower shaft downwards, the same principle as bracing your knees behind the wheel.

December 2017: John Bilham had to go through a similar process when installing PAS but was more persistent than I was. He writes:

> Unfortunately the kit was supplied with an earlier modified steering column (presumably pre 410000, BHH1596, mine's an ex-US '77 Roadster, BHH1856). The only problem this presented me with was the difference in the aluminium bearing carrier at the steering wheel end - mine has a smaller diameter section where the switchgear sits. Rather than send the whole thing back for a replacement (I live in France) I decided, after a conversation with the vendor, to swap the bearing carriers.
>
> I decided to remove 'my' bearing carrier first, so drilled the heads off the three rivets hoping to just slide it off the column. That didn't work, but on closer inspection I noticed that in addition to the large inside circlip which retains the bearing (I wasn't going to remove the bearing itself), there was another small outside one sitting on the shaft in front of the inner ring of the bearing. When I removed this the carrier and bearing slid off. Looking at the exposed shaft, there is the slot for the circlip, then a rubber oil seal, similar to that on a valve stem, that the bearing sits on, and then what looks like another slot, although it's difficult to see.
>
> 
> When I drilled the heads off the rivets on the other, supplied, column, the carrier moved a few mm but wouldn't slide off. This column has the large inside bearing-retaining circlip but not the outside one on the shaft. I then realised the heads had come off but the rest of the rivets had remained in place and these were obviously catching on something hidden on the column. They couldn't have been very tight because they just rotated with the drill bit, and were still long enough to almost touch the shaft. Took enough off them to allow them to fall out and the bearing casing just slid off. This revealed an outside circlip similar to mine, but this was sitting behind the bearing (which was what the remains of the rivets were snagging on) but with a similar oil seal in front of it.

Mystery 1 is why one column had the outer/shaft circlip behind the bearing and the other in front. Mystery 2 is why there is not an outer/shaft circlip on **both** sides of the bearing. My upper shaft (when the inner was not fitted) would not move either up or down inside the column outer while the bearing was retained by the inner/housing circlip. Both of John's bearings and housings slid off his shafts, so were not a press-fit. Assuming mine (being the

same as one of John's) was not a press-fit either, what stopped that moving downwards in the column outer unless it was a second outer/shaft circlip on the steering-wheel side of the bearing?


Further investigation by John (more than he needed to do for installing his PAS for which I'm grateful) dismantled the bearing housing into housing, bearing, shim and circlip and revealed all, click the thumbnail.

Subsequently John writes:

> I then discovered that the new steering column was also 10-15mm longer than mine, taking it beyond the range of adjustment provided by the brackets that it bolts to under the dash, and I am currently working on this. It also jeopardises the position of the column vis-à-vis the column down to the rack (they are too close). The end of the new steering column, where it passes through the firewall, is now supported by a swivelling bearing housing, seemingly to compensate for the absence of the third column support under the dash, to provide adjustment when aligning the column and the rack's column, at the u/j. The three holes in the housing, however, do not align with those in the firewall and the captive nuts beyond, and would need to be bigger anyway to provide some adjustment. So far I have drilled them out sufficiently to align with the holes in the firewall, and may well need to make them even bigger to provide adjustment when I come to fit the u/j.

But back to the repair ...


... and to somehow join the two halves of the inner shaft back together. They are sort of rectangular section where they slot together (to guarantee still being able to steer even if the pins shear!), which has to have some clearance of course. There are holes in the outer, and a 'waisted' section under each hole in the inner. Plastic/nylon is injected through the hole on one side, filling the waisted sections and the gap between the two halves of the shaft, and exits from the hole on the other side. The broken ends of the shear pins came out of the lower half of the shaft easily enough, and the moulded inserts can be eased off the upper half. Whether the moulding around the waisted section always compresses over time to give some play, or whether mine only had the play because the pins had sheared I don't know. I decide to leave the remains of the injection moulding in place as removing them could introduce even more play, but need to pin the two halves of the shaft together. I can see where the pins have sheared off, so mark this position on the outer casing, then slide the lower half of the shaft over the upper until the holes in the outer line up with my marks, i.e. they are over the middle of the waisted sections. I use the holes in the outer as a guide and drill through the inner, so I can insert a pin all the way through.


I decide to slather some Araldite under and round the two halves of the nylon insert, and inside the holes in both upper and lower sections, so that when the lower half is pushed back over the upper that, and a pin through the hole, should hold the two halves together and take out the rotation play between them. Some people have said they used a hot-glue gun to replace the nylon shear-pins, but as described above there is a strong spring trying to pull the lower half of the inner out of the bottom of the outer, but the upper half of the inner is retained by a bearing at the top of the outer, so the force of the spring is being exerted on the repair. I use a metal pin in each position, not being bothered about changing the collapsible characteristics after all these years, **you do this drilling and pinning at your own risk!** Note that the two halves of the shaft will fit together in two positions 180 degrees out. Oddly both my rack and column shafts have notches for the UJ bolts rather than one shaft having a notch and the other a groove all the way round, so my column and rack shafts will only connect in one position,

which means if I reassemble the column shaft 180 degrees out the indicator cancelling cam will end up in the wrong position (as it would if you had a shaft with a groove, match-marked it, and reassembled to that). No big deal as it is only a friction fit on the shaft and can be slid round, but nicer to get things correct in the first place.

Leave that to set a bit and start tidying up the wiring, which basically consists of putting bullets back on the ends of the original brown wires in the harness and ignition switch tail. However as I have no less than four additional circuits that need to connect back to this brown, rather than have a veritable daisy-chain of bullet connectors I splice three of them together with one bullet (two have in-line fuses close by and the third connects to a relay with a spade also close by, so easy enough to isolate each of them for diagnostics) and use the fourth hole for the alarm wire as that goes across the car to the alarm unit in a mini-harness. Turn the power back on and check everything electrical still works, even though the switches are still dangling, and the horn button is removed with the wheel. It's while doing this I discover a thick washer on the carpet, same size as the three that are still on the upper bolts - wonder where that came from...

I then start thinking about the pesky bottom spring and circlip. As I said it is pretty hefty, and just with hand pressure I can't get it compressed far enough to get the circlip on - nowhere near. I'm thinking I'm going to have to lever it down with something, but it will have to be pretty thin as there is going to be very little room to fit the circlip in its slot. I find some flanged plates about 8" by 2" from my BT days some 30 years ago (!) which may be strong enough. I cut a hole in this plate, which just fits over the end of the part of the shaft the circlip fits into, which is narrower than the part that the spring and a washer fits over. As I've only got two hands I stand the steering wheel end of the column on a suitable block of wood, put one end of my plate under the edge of my bench, and press down on the other end of the plate with a hand. It's compressing OK, but the problem is the washer is catching on the shoulder of the shaft, and as I'm levering rather than a straight press it is proving impossible to keep this washer aligned with the larger diameter it is supposed to go over while I'm levering. Go and gaze at my various bits again, and see an old box plug spanner which looks interesting. I'm amazed to discover this just fits over the narrower part of the shaft, and also just fits inside the washer and spring, so perfect for aligning the washer with the thicker part of the shaft! So now I put the box plug spanner through my plate, put the washer and spring on the end of the box plug spanner, and slide that lot over the end of the shaft. Now levering on the plate pushes everything over the larger diameter, and I remove the box plug spanner to reveal the circlip slot - so far so good. However it's still a bit of a fiddle picking up and manoeuvring the circlip one-handed while pressing down on my lever with the other, so I devise a system of string and a tommy bar (from the same plug spanner!) to pull the plate back and compress the spring while the column is clamped in the vice, and I have two hands to fit the circlip. Easy-peasy? - er no. Of course I have forgotten that the circlip is now trapping the plate! But filing the hole in the plate out to a 'keyhole' shape slightly larger than the circlip, but still smaller most of the way round than the washer, I can now fit the circlip into its slot, and lift the plate off over it. Feel thoroughly pleased with my ingenuity, and life-long policy of never throwing anything away - "If you haven't found a use for something yet, you haven't kept it long enough". In fact I have had a major clear out of the garage recently as we are planning to move house this year, but obviously kept enough of the right bits! Finally reattach the plastic cover over the mesh section of the outer, taping it up with masking tape while the adhesive dries.

And now for the refitting and alignment! There is a small ring welded to the outer tube, which the loose plate butts up against, so I wondered if it should be attached to that, although there was no sign it had been. However

that puts the plate about 1/2" away from the toe-board which obviously isn't right. And with this column unlike earlier types the inner is fixed in the outer and cannot move up and down, only rotate, so the whole column has to be able to move up and down to get the right distance from the rack shaft so the UJ bolts will fit through the cut-outs in the shafts. Although some have said this bottom plate is part of the alignment, pushing the bottom of the column into the correct position, I've come to the conclusion it is nothing more than a body seal against water, noise and fumes. Two people have confirmed that theirs is also loose and detachable (making it odd that Moss Europe at least show it as part of the column), and another has said the same and that he has a rubber bush, that slides onto the lower part of the column outer, and makes a snug fit to the hole in the plate.

August 2016: That makes more sense, and Moss Europe have a closeup of this plate and the rubber seal, where part of the seal pushes through the hole in the plate. However they show the seal having been slid onto the column first, then the plate. As there are bolts that go through the plate, seal and toe-board one would expect the seal to be sandwiched between the plate and the toe-board, i.e. the plate pushed on first, and the seal after it. When the column and rack-shaft have been correctly aligned over-size holes in the plate and/or toe-board should allow bolts to be pushed through and tightened to provide clamping, but not alignment. In practical terms it was easier to loosely bolt the plate and seal to the toe-board first, then push the end of the column through the hole, rather than slide the plate and seal onto the column, put it in position with at least one upper bolt, then try and get the plate bolts in - the top one in particular is a real fiddle but all are more difficult that way. Now the seal and plate are positioned laterally and vertically **by the column**, and when the plate bolts are tightened it compresses the rubber such that it expands sideways and seals to the column shaft, as well as being bolted down to the toe-board, to prevent the ingress of water.

Another thing concerns the alignment gauges. The book says to remove the **rack**, even when it is the column that is being refitted. You **do** have to remove the rack later on, but there is no point doing it now only to have to refit it, then remove and refit it a second time later on. If using the Moss gauges these have two tapped holes depending on which rack and column they are used for. Compare the gauge to the UJ, position the tip in line with the centre of the UJ, and see which hole in the gauge lines up with the clamp bolt hole in the UJ, and put the clamp screws in those holes. Note that each part of the Moss gauge seems to be a couple of milli-metres shorter than the rubber bumper UJ (not so the chrome bumper), so bear this in mind when doing the alignment i.e. leave a couple of mil between the points or you may not be able to get both UJ clamp bolts in right at the end (alternatively, fit the UJ first, nip up the column bolts to get the correct in and out adjustment, then pull the rack forwards to replace the UJ with the gauges and note the gap between the tips, if any. When you have corrected the column and rack shimming for horizontal and vertical alignment make sure you end up with that same in and out gap). Apart from that when refitting a column it's easier to fit the alignment gauges first, minus the screw in the column piece. Then fit the column loosely, the alignment gauge easily goes through the toe-board plate and seal, and then fit the screw to the column half of the gauge. This is a bit fiddly being recessed into the toe-board 'cup' as it is but can be done. It would be easier with a knurled bolt, or even a hex bolt, or if the screw could be pushed in to the hole a little way before the threads started. Note that the screws must screw into the bottom of the cut-out in the shafts, not onto the splined portion. My Haynes is completely wrong here, by saying the rack and column should be fitted **before** installing the alignment gauges. This simply cannot be done, the two have to be moved apart a couple of inches to get the gauges onto the shaft, and off again to refit the UJ. With the gauges on adjust the column position and the shims as above to get the correct alignment. However my Leyland Workshop Manual also has a major error, in that it tells you "Slacken the screw on the column point gauge and slide the gauge down until the points of both gauges are on the same plane but not overlapping". The whole point of the gauge screws with this column is

that they **must** screw into the cut-outs in the shafts, and the whole column must be slid up and down to get the correct in and out position. Unless you do this it is highly likely that you will **not** be able to get the second UJ clamping bolt inserted, the cut-out in the shaft not lining up with the hole in the UJ. This isn't the case with earlier columns, where the whole inner shaft is free to slide up and down inside the outer, with those the shaft will automatically take up the correct position. I repeat, with this later energy-absorbing column you can only adjust the in and out position of the inner, and hence get the cut-out in the correct place for the UJ, by moving the whole column on its upper bolts (which is also why the toe-plate must be able to slide up and down on the column outer).

Additionally at the end of the process i.e. with the gauges replaced by the UJ, it tells you tighten the two upper bolts, then measure the gap at the third bolt, and fit shims accordingly. This makes no sense to me, as the gauge of the correct size would have to be gripped by almost the same tension as the final shims which is 12-17 ft lb as you were sliding it in and out. Better to align, fitting shims as required to the third bolt and tightening all three to get the correct alignment while the gauges are still on the shafts. More long-winded certainly, but it seems more accurate to me. The two upper column bolts do not allow the column to 'rock' on them when tightened, so unless the shimming required on the third bolt is negligible to nothing then there must be some sideways pressure on the UJ and hence the rack pinion bearing. If you shim the column to that final position, then the two shafts will **not** be accurately aligned. When the column and rack shafts are correctly aligned with the gauges, only then pull the rack forwards to remove the gauges, fit the UJ, and refit the rack. Unlike the column, the rack (with any shims) should **always** go back in the same position. Whereas if you are only fitting shims to the third column bolt and fully tightening that after the UJ is installed, you could be affecting the vertical alignment, and indeed would have to lever the bottom of the column downwards in order to get the shims inserted. This is why it makes more sense to fit the gauges before installing the column, leaving the rack where it is until the very end of the process, only then pulling the rack forwards to remove the gauges and refit the UJ. Note that if you raise the front wheels off the ground you only have to remove the four rack bolts, leaving the track-rod ends attached to the steering arms. As you pull the rack forwards a few inches to allow you to remove the gauges and fit the UJ, the wheels will simply go 'pigeon-toed' i.e. turn in towards each other.

Refit rack bolts, tighten UJ clamp bolts, refit switches. Check all the electrics again, which involves putting the key in the ignition, and immediately sense that it is now closer to the bottom of the dashboard than it was before. I now realise what that odd thick washer was - it must have been between the column and body brackets on the right-hand bolt which would space that side down a bit - buggah! To fit it now would involve realigning the column. Consult the workshop manual to find something I missed before, that there should be such a spacer on **all three** upper column bolts! Indeed six shown in the Leyland Parts Catalogue, but only three in online parts lists. However the manual talks in terms of "if the packing washers are mislaid" so it is probably no big deal, and I can live with it until I next have to remove rack or column. Refit the column cowls **before** the steering wheel as it is easier, and if the lower cowl screws (covered by the edge of the dashboard) were fitted before don't bother refitting them, they just aren't needed. If you haven't upset the positioning of the indicator cancelling cam, and it was correct to begin with (cam pointing at the switch when straight-ahead), then loosely refit the steering wheel to turn the shaft to the straight-ahead position, then refit the wheel fully. Otherwise fit it with the nut not fully tightened, take it to a quiet straight road close by (not 10 miles away!), and adjust as required. Take your socket etc. with you so as to fully tighten it before driving back, so you can take the scenic route and enjoy getting your car back on the road again. The rattle-free steering really is an improvement.

Steering Wheels

According to Clausager four different types of column and wheel hub splines were used over the years, and are not interchangeable. See here for the various change points.

As far as the wheels themselves go the first had wire spokes in three groups. For 1970 it changed to three flat spokes with five holes each, inside a steel rim, padded with dense foam, with a faux-leather covering. In 1973 the five holes (said to have trapped fingers!) were replaced by a tapered slot, but only until June 73 when the slot became simply a depression in each solid spoke, as the slots were found to trap dangly bracelets! For 1977 to the end a wheel with four plastic spokes was used, except for the North American LE of 79-80 which oddly went back to spokes with holes in again, albeit only three in a smaller diameter wheel. It seems likely that wire, original alloy with holes, alloy with slots and alloy with depressions, and finally plastic and American LE have the four different splines.

The wheel is fitted to the shaft with a splined and tapered joint and a nut (about 1 1/16" or 3/4" Whitworth on my 73 roadster and 75 V8), which together means that even if the nut comes loose the wheel should not be loose on the column, the taper must be 'broken' as well. I've seen pullers recommended, but can imagine these damaging the back of the spokes or hub. The best way of doing this to avoid damage to both wheel rim and column is as follows:

- Remove the horn push or centre cover (varies with model)
- Slacken the nut by just a turn or two - make absolutely sure that plenty of turns remain engaged and the nut does not protrude too far above the end of the column.
- Sitting in the drivers seat, draw your knees up behind the wheel and use them to apply pressure to the back of the wheel rim.
- Wearing appropriate eye protection, place a drift on the end of the column shaft making sure it is in contact only with the shaft and not the nut or you will damage the threads.
- Strike the drift firmly with a hammer.
- After a couple of blows the wheel should pop free, but be safely retained by the nut which prevents it from flying towards your face.

I've seen it claimed that this method can cause the collapsible shaft to collapse. But as far as the upper shaft of the rubber bumper fully collapsible column goes, there is an top bearing that retains the upper half of the shaft in the outer, which prevents it going any further into the column, and in any case bracing the knees behind the wheel is going to counteract any downward movement, the shock of the blow releasing the taper. It's possible it could happen on the earlier collapsible column as the whole shaft is free to slide up and down in the outer, so there is an alternative method. This involves slackening the nut as before, then alternately pulling one side of the rim towards you and pushing the other side away from you, with force, as if you were trying to buckle the wheel, and repeatedly reversing. This method didn't work for me when the wheel hadn't been off for a long time, but it did on subsequent occasions.

March 2017:

Ray Longsheds wrote saying he was intending to replace his three-spoke wheel like for like, and wondered if this could be done by undoing the six bolts under the horn-push, to avoid any problems of removing the hub from the column. I didn't see why not, so he went ahead which worked just fine. Once off his old wheel showed some distortion in the spokes, possibly due to the alternative removal method above!

Update August 2011:

After living with the Moto-Lita on Vee for 17 years and wondering about getting an original, I suddenly decide to do something about it. Contact Andy Jennings and he does have one available at £20 plus p&p. The condition as described and in a photo looks good enough so I go for it, it arrives next day, and if anything is better then expected. First thing is to make sure it fits, which it does. The hub needs repainting which is no bother, the horn-push is perfect, and the rim which is the most important thing as it would be a pain to do anything about is near perfect. The hardest job concerned the spokes, which had obviously been wire-brushed with a drill in the past, but across the spokes as well as longitudinally leaving score-marks in both directions, whereas the original brushed surface would have been longitudinal only. I try model-makes wire wool, and various grades of wet and dry up to the coarsest I have which is 400 grit. I manage to greatly reduce the scoring but not totally eliminate it, and even 400 grit leaves the remainder of the surface polished instead of brushed. I even try a hand wire brush on the back (which I'd also done with the 400) in an attempt to recreate the brushed look but it made no impression. I could have tried my grinding stone, but wouldn't have been able to get into the depressions in the spokes, so settle for a wire wool polished finish. Vee is a 75-built car eligible for the gold 50th anniversary badging, so I paint the MG logo on the horn push as shown in Clausager, albeit with Humbrol gold instead of the yellow he describes. Andy couldn't supply a sprung pencil for the horn connection, I could have got a new one but a wire soldered from the back of the slip-ring to a tag on the centre screw of the horn push does exactly the same thing and saves £10. Fitted, it makes the steering even lighter than I was expecting, and at least now I can see the supplementary gauges without peering round the rim.

1977 (and later) model-year cars have a special wheel boss which engages with a cancellation collar on the indicator/turn switch, see here. A non-standard wheel is likely to fail to cancel the indicators without a modification as indicated.

Steering wheel alignment *January 2017* The steering wheel should very obviously be 'straight' when travelling in a straight line, and not turned to one side, and there are several ways of achieving this. There is a second aspect to this, and that is indicator cancelling. On pre-1977 cars this is done by a peg or cam attached to the steering column, which with the car travelling in a straight line should be between the cancelling fingers of the indicator switch, to get balanced cancelling each side. If it's unbalanced one side may not cancel unless the wheel has been turned more than would be normal for a typical turning. There is a third aspect on cars with a steering lock, and that is how far you have to turn the wheel from straight ahead to get the lock to engage. If you habitually make sure the lock engages you could have to turn the wheel up to 180 degrees to do so, so if you need to remove the column or rack for any other reason it might be an opportunity to correct the steering lock, reinstall the UJ appropriately, and then correct the cancelling cam (which is used on all locking columns) and steering wheel.

The first aspect can obviously be corrected by positioning the wheel on the column splines appropriately. However on Mk1 cars indicator cancelling is done by a peg screwed into the column i.e. the column should be in a specific position relative to the switch when travelling in a straight line. If it's the column that has become misaligned then simply moving the wheel will leave indicator cancelling incorrectly set even if you correct the wheel position. On those columns you are left with altering the position of the column UJ on it's respective shafts to correct the column, and hence the wheel. Mk2 cars up to 1976 have a cam that can be slid round the column into the correct position for the indicator switch. So on these cars a combination of sliding the cam round and moving the wheel will correct both problems. On 1977 and later cars with the four-spoke steering wheel the cancelling mechanism is part of the wheel itself, so moving the wheel will correct both aspects.

On cars without the full energy-absorbing column the column shaft has a notch for the UJ clamp bolt, meaning that the UJ can only fit to the column in one position. But the rack shaft has a groove all the way round, so this has to be used to correct column and steering wheel alignment on Mk1 cars. It can also be used on some later models, but on my V8, and possibly all RB cars, both column and rack shafts only have the notch, meaning the two shafts and the UJ can only be assembled in one orientation. However these cars have the sliding cam that can be used to correct the indicator cancelling position, so that and the steering wheel can be moved on the column shaft to correct the alignment.

I say 'correct' but none of the above can correct alignment to anything finer than one spline, so you could end up with a choice of having the wheel offset one way, or the other, but not dead-centre. However fine adjustment can be done at the track-rod ends. Do this by finding an area big enough to roll the car forwards in a dead straight line - going by the direction of the car and **not** by the angle of the steering wheel. This will leave the wheel off-centre, and we can adjust the track-rods until the wheel itself is central. For example, if the steering wheel is slightly turned to the right when travelling in a straight line, i.e. the road wheels would be turned to the left to get the steering wheel central, then we need to move the road wheels to the right to get both them **and** the steering wheel in the straight-ahead position. To do this **unscrew** the off-side track-rod from its track-rod end to push that wheel out to the right, and screw the near-side track-rod into its track-rod end by exactly the same amount to pull that wheel in. If the steering wheel is turned to the left when the car is travelling in a straight line then the process is reversed i.e. unscrew the near-side track-rod and screw in the off-side track-rod. Go by whole turns to start with, then half and quarter turns, a paint spot on each track-rod will help you keep track ... so to speak! Alternatively if you go to a decent wheel alignment place that does four-wheel tracking they will get the car pointing more or less straight, then turn the steering wheel to straight ahead and clamp it there, then adjust each track-rod to get half the overall toe-in on each wheel. However that may upset the indicator cancelling!

Another aspect of steering geometry is that strictly speaking you should have the same number of turns from straight ahead to each lock, so the turning circle size is the same in both directions. If one wheel turns in more than the other it could rub on something else on full lock. You can correct this in the same way. Determine any off-set by rotating the steering wheel fully one way and note the angle of the central spoke to the vertical, then rotate it fully the other way and again note the angle. Or you can put tape at the top of the rim when the wheel is pointing straight ahead, and note how far that is off the vertical on each lock. Ideally the angle should be the same on both locks. If it is different you can correct it by offsetting the wheel on the column so that the number of turns to each lock is the same **at the steering wheel**, i.e. with the wheel in the straight-ahead position the road wheels will be offset to one side or the other. Then use the above process i.e. position the road wheels so that the car would travel in a straight line and the steering wheel is offset, then adjust the track-rods to correct the steering wheel. However this would be quite a bit more complicated with the early columns with the screwed-in indicator cancelling peg, as the steering wheel would have to be offset by moving the UJ on the rack shaft, rather than moving the steering wheel on the column shaft.

Track-rod Ends

May 2017: Following a comment on the MGOC forum I learnt that there have been two types of steering arm and track-rod end. What the Workshop Manual describes as 'early production cars' had a washer under the nut securing the TRE to the steering arm. Later cars had a narrower hole in the arm, the TRE pin was longer, and the nut is deeper. Originally there was a washer fitted under the nut, the later items have no washer. But the later TREs can be fitted to the early arms, just leave the washer out. The change must have been pretty early as there is only one part number for TREs and one (per side) for steering arms in my Parts Catalogues.

Using wedges and pickle-fork so-called ball-joint splitters I had never been able to disconnect the track rod end from the steering arm to either replace them or gaiters without damaging the rubber boots on them i.e. destroying them in the process so unless I was changing them anyway I didn't even try. But to change track-rod ends you will have to disconnect them from the steering arms of course. Eventually I bought a ball joint separator but had to modify it, now splitting track-rod end tapers is a positive joy. Make alignment marks on the tie rod and track rod end, slacken the lock-nut and count how many turns are needed to separate the track rod end from the tie rod. If refitting the same track-rod ends you **should** be spot-on, but unless you know your tracking was right before there is no harm in getting it checked, and you know you will be able to slacken and adjust everything before it all seizes up again (and if you reassemble with copper grease it is much less likely to seize-up anyway).

A tip when disconnecting the track-rod ends from the steering arms. The nut is usually a Nyloc, and the effect of this is that once the taper is broken turning the nut just turns the pin with it unless you lock the taper again, as otherwise the stud just turns the ball in its joint. And if using a screw-type splitter you really need to have a nut on several threads to avoid damaging the end of the stud. The tip is before cracking the taper remove the Nyloc nut, then put a plain nut on until the end of the stud is close to the face of the nut, then use the splitter. As long as the threads are good the plain nut will be much easier to remove once the taper is broken. For replacement the same problem occurs, so screw the plain nut up tight to lock the taper, then replace with the Nyloc nut.

If changing track rod ends and they are basically the same length alignment marks and counting turns will probably get you close enough to drive straight (hopefully!) to an alignment centre, which should be done as there are bound to be dimensional differences between old and new track rod ends. However changing Bee's track-rod ends I found the new ones were quite a bit longer than the old, so no point. I measured the difference as best I could at 6mm, then screwed the lock-nuts back towards the gaiters until there was a 6mm gap to the ends of the old track-rod ends, and removed them.

The old ones were surprisingly bad given they were only advisories, the worst had lost a large part of its rubber boot, the ball was sloppy in its joint and rusty. The other one had a split boot and was rusty inside, but the ball wasn't as loose. I then screwed the new ones on right up to the lock-nuts. Not happy that I had got the tracking close enough for driving to the alignment place I decided to make an alignment gauge. Having (hopefully) got the tracking close enough for a test drive it was immediately noticeable how smooth the steering was, I had recently been aware of some vibration through the wheel, which wasn't consistent so I didn't think it was wheel balance. Also quieter, as if I had subconsciously noted some rattling, both must have been coming from the worn UJ as well as track-rod ends. I suppose it is a case of not noticing gradual changes in sound and feel over a long time, whereas we should all be aware of sudden changes and either know what they are (as in this case) or investigate them - Nory's "Listen to your car, it is talking to you".

Just after replacing Bee's I find that Vee's need doing as well, as a result of investigating a clonk when applying and releasing the brakes, which led me to discover a clonk as I turned the steering wheel back and fore with the road wheels on the ground, which felt like it was the track-rod end but could be the rack! But this time the offside at least looks heavily corroded. I buy two more track-rod ends plus lock-nuts as it looks I might have to use an angle-grinder on both. I don't have a spanner that fits, and my mini-Stilsons isn't giving me enough leverage as well as chewing up the nut, so a trip to Halfords with a new nut gets me a 22mm which is a

pretty close fit. That gets the nut turning on the track-rod, but the track-rod is stuck fast in the track-rod end. My Stilsons grip the track-rod to some extent, and a large ring-spanner over the end of the handle gives me more leverage, but being round bar eventually it just slips, even having applied Halfords 'shock and oh' releasing fluid ('shock' from the freezing spray as well as the penetrating fluid, 'oh' from the 'oh bugger' when it doesn't make any difference). So nothing for it but to run the angle-grinder along the length of the track-rod end until the tips of the threads just start to appear. Get the Stilsons on the track-rod again, hoping the heat from the angle-grinding might have done the trick, with more freezer spray on the exposed threads, but still no go. So this time I put the Stilsons on the end of the track-rod end, pin still in the steering arm, in such a way that it is trying to peel it open, and finally hear a 'crack'. After that it comes off relatively easily, only took a couple of hours... New and old look to be the same lengths, so count the turns to remove (21) and fit the new one (with copper-grease!). I decide to leave the old nut on, screwed back a bit, plus a new one, thinking that in future the two nuts locked together will give me more purchase to turn the track-rod.

When I come to do the second one I don't have much time but put the spanner on the locknut just to see what happens and it moves straight-away. Not only that it is screwing the track-rod out of the track-rod end. So crack the taper to the steering arm, unscrew (18 turns), and screw the new one on. This one already has copper-grease on it, I'd forgotten I had already dealt with that one some years ago when replacing a gaiter. Shows just how effective the grease is, and second nut on the other side obviously not required. This one takes me 10 minutes start to finish! All I have to do now is check and adjust the tracking with my gauge. Well, I say 'all', but having gone from king-pins to track-rod ends and noticing a broken bump-rubber on the way, this time I noticed the A-arms on the left side weren't being held centrally on the bushes on the wishbone pivot, but were both as far back as they could go, the front one up against the face of the pivot and the rear one against the retaining washer. Annoying as I replaced A-arms and bushes a few years ago and they are the correct V8 ones. In theory this might have altered the suspension geometry, which could account for a very slight drift to the left on a flat surface, which implies a difference in castor angle between sides. But the direction the A-arms have moved is rearwards, which would have **reduced** the castor angle that side, which in theory should cause a drift to the **right**. So something else to investigate further. Used the alignment gauge again, the kit at my local tyre place should fit the V8 wheels OK as a double -check. But just like Bee it was immediately noticeable how much quieter and smoother the steering had become. After finally getting the wheels balanced correctly I was left with an occasional tremor over some surfaces, which I put down to the slight wear that I know exists in the rack, and the free-play in the column. On a 70 miles run there was absolutely nothing - excellent result.

Tracking Alignment

Making an alignment gauge, but first some points about tracking and alignment:

- The alignment of the front wheels, or tracking, is adjusted by screwing the track-rods into or out of the track-rod ends.
- If the rack is in front of the axle (as on the MGB), and the track rods are screwed into the track-rod ends, the front of the wheels are moved closer together and the back of the wheels moved further apart. If the rack is behind the line of the axle the opposite is true i.e. screwing the track rods into the track-rod ends moves the back of the wheels closer together and the fronts further apart.
- If the fronts are closer than the rears the wheels are said to be toeing in, and this is the normal arrangement for most cars, but by no means universal, and the amount different cars toe in or out also varies. The MGB (including V8) is adjusted to toe-in 1/16" to 3/32" (1.5 to 2.3mm, although some laser machines need degrees. That needs the wheel diameter as well (why on earth do these people feel the need to complicate things?), and for 14" wheels that's 15 to 22 minutes, or 0.25 to 0.37 degrees. For 15" wheels it would be 14 to 21 minutes, or 0.23 to 0.35 degrees, see this conversion chart), unladen. This is

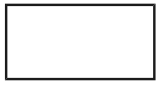
total toe, i.e. between the two wheels, half of that between each wheel and a notional centre-line.

- The purpose of toe, either in or out, is to reduce the amount the tyre scrubs against the road surface, the more the tyre scrubs the faster it will wear. If a tyre is toeing-in too much, the outer edges of the tyres will wear more rapidly, in a sort of stepped fashion. And if they are toeing-out too much the inner edges will wear more rapidly. If one tyre wears different to the other, then that is an indication that other aspects of steering and suspension alignment are unbalanced between sides, and this can include problems at the rear. It can be caused by accident damage and chassis misalignment as well as damage to or wear in suspension and steering components. It is the various suspension angles - camber, castor and king-pin inclination that determine how much toe is required to produce zero scrub, and in which direction.
- It is incorrect to say that if the car is pulling to one side or the other on a flat and level road then the tracking is out (although it may be). The front suspension is designed so that when travelling forwards the steering self-centres, so you don't have to pull on the wheel to straighten up after a bend, and there is no tendency to wander from side to side needing continual corrections when travelling in a straight line. This is achieved by the castor ('caster' is a type of sugar, or a container for sprinkling it) angle of the king-pins, which is the amount a line through the centre of the king-pin is off vertical, in a fore and aft direction, the bottom of the king-pin being further forward than the top. Clearly seen on a bicycle or motorbike where the line of the forks up through the frame is angled (bicycles and motorbikes also have the rotational centre of the wheel set forward of the line of the forks, which is called 'trail', from having curved forks on a bicycle and the axle bracket attached to the front of the forks on a motorbike). Forward motion with turned steering puts the contact patch to one side or the other of a notional centre-line, and it tries to pull back to that centre-line, just like a shopping trolley wheel. If the castor (and all the other) angle is the same on both sides then the centralisation forces will be the same both sides, and regardless of how much the toe in or out is both tyres will be at the same angle and the car will travel in a straight line. If it doesn't, on a flat and level surface (the usual camber for rain-water drainage will always tend to pull the car towards the side of the road), then it means the castor angles are different between sides, and the car will pull towards the side with the greatest castor angle.
- On the MGB the castor angle is between 5 and 7.25 degrees, and not adjustable, except possibly using clearances between bolts and holes by slackening the damper mounting bolts, and the A-arm inner pivot to crossmember bolts, and applying appropriate leverage while you retighten. In theory, if the car is pulling to the left, the left king-pin is more inclined than the right, so pulling its damper backwards or its A-arms forwards, and doing the opposite on the other side, might have an effect.
- When checking or adjusting tracking the car must be on a flat and level surface, with the suspension at its working level i.e. bounce it up and down to settle it if the front of the car has been raised and roll it back and fore a few times, with the tyres at correct and equal pressures, and the wheels in the straight-ahead position. This last is to remove the effects of the Ackerman Angle, which is where when cornering the inside wheel turns more than the outside wheel, to reduce scrub, steering effort and loss of traction, as the inside wheel takes a shorter line than the outer. Similar to why a driven axle has a differential, although in that case it is to prevent drag, wheel skid and loss of traction. If you measure the physical toe with the wheels off-centre you reduce the toe-in, maybe to the point of making them toe out. If you adjusted them to the book figure like this they will be toeing in more than they should be when straight ahead. On the MGB when the inner wheel is at 20 degrees the outer wheel is at 19 degrees (+- 1 degree).
- When adjusting the tracking, if the steering wheel was previously straight when travelling in a straight line, then **both** sides must be adjusted by an equal amount. If you only adjust one side then the steering wheel will end up at an angle when travelling in a straight line, and you may upset the indicator cancelling position.

- The other aspect to steering is the lock each side, or how far the wheel can be turned in each direction. Ideally there should be **exactly** the same number of turns from straight ahead to the right lock and the left lock. Compare the angle of the wheel spokes at one lock to the other, and it should be a mirror image. If the wheel turns more to one lock than the other then that will give different turning circles one side to the other. No big deal with small amounts, but if it goes too far the wheel could rub on something, as well as making manoeuvring awkward. There is more information on steering wheel and indicator cancelling alignment here.

Tracking can be measured in one of two ways - physical measurement of the tyres and wheels, or the amount of scrub. I've never used it but Gunson's Trakrite measures the scrub, or side-slip, by pushing the car forwards with one wheel over the device which consists of two plates, one on top of the other, with ball-bearings between them. Any scrub will tend to push the top plate sideways relative to the bottom plate, and this relative movement is displayed on a scale. You adjust the tracking (both track-rod ends equally remember) to give zero scrub or as close as you can get, my Celica manual for example quotes a maximum of 3mm per meter, or 0.118" in 3.3 feet(!) in either direction. You only have to measure one side, as the grip between the tyre and the ground on the other side will push or pull the tested tyre the whole amount of the scrub for both tyres. Therefore get the tested tyre to zero, and the other should be at zero also. Out of interest the toe on the Celica is +-1mm, i.e. neutral or zero toe, which is quite common for front-wheel drive cars.

As well as describing measuring side-slip or scrub the Celica manual has a detailed description of how to measure the physical amount of toe. Basically you mark the middle of tread, in line with the centre of the axle, on the front or the back of the tyre, and measure the distance between the two marks, which is most easily done with two pointers on a connecting bar resting on the ground. Then roll the car half a revolution, so the marks on the tyres are now on the other side but back in line with the axle centre-line again, and again measure the distance between the two marks. If you carefully move your pointers from the first (reference) position to the second (comparison) position, and line up one pointer with its mark, you can directly measure the total toe between the other mark and its pointer. If you take the reference measurement at the back then roll the car forward to make the comparison, or vice-versa, so the marks aren't scrubbed off on the ground. If adjustment is required this method obviously needs you to move the gauge between the back and the front of the tyres several times, making small adjustments to the pointers each time, and being careful not to knock the pointers when moving from the reference side to the comparison side, in addition to rolling the car back and fore several times (which applies to both methods). The side-slip method will certainly be easier, but at a cost of typically £75 as opposed to perhaps nothing if you have a long enough broom-handle and some thin rod, considerably more expensive for something that may only be used once per year at most.



Having recently had a major clear-out of garage and shed I didn't really have the makings without butchering a garden tool or two, so for a few quid I bought some square tubing, threaded rod and nuts from B&Q. I measured the distance between the centre of the treads on each wheel, and this gave me the nominal spacing of the pointers. I also measured the ZS, which is quite a bit wider, and made the bar just long enough to take the pointers at this spacing, in case I ever needed to do that car as well. I drilled hole through the tubing (at the MGB spacing) to take the threaded rod, then overdrilled the bottom hole to allow a cap-nut to pass through which would be on the bottom of each rod. A butterfly nut further up the thread, above the tubing, clamps the rod in position. The rod rises vertically from the tubing and is then bent forwards to meet the mark on the tyre, it's overall length being such that the pointer touches the centre-line of the axle. I subsequently noticed that Moss have a similar gauge at about £50 so quite a bit cheaper than a Trakrite, but not as cheap as mine! However the instructions on the ordering page simply to measure between the outer sidewalls at the front of the tyre, then

compare that with the backs. That would require the tyres to be perfectly mounted on the wheels, with no run-out. At the very least the car should be rolled back and fore half a turn so you are comparing the **same point** on the sidewalls, as I am doing with the centre of the tread.

Subsequently took the car to my local tyre place for a tracking check to find their stuff would not fit over/round the spinners, also my next local place. The fronts could be turned so that with the ears at an angle the laser unit fitted round them, but at the back it is a single central vertical bar and even the body of the spinner sticks out too far for that. Good job I got them (hopefully) close with my home-made gauge, looks like I have a 20 mile drive to the next nearest place with kit that should cope with them. **One week later...** Some nice weather at long last so a trip through the countryside to a place with screw-in adapters that hold the gizmos further out from the wheel hence clearing the spinner. Tracking is a shade under 2mm toe in, so given that the spec calls for 1.5 to 2.3mm I call that a result! Even more of a result is that checking is free, only adjustment costs!!