CONVERTING THE J, P, L & N GEARBOX TO TAKE DRAWN CUP NEEDLE ROLLER BEARINGS

My dislike of the "Hyatt" type roller bearings originally fitted to the Wolseley gearboxes of early M.G. cars is quite well known and for some years I have been trying to source modern high speed precision ground bearings comprising an outer shell with a separate inner sleeve to fit exactly into the inside bores of the standard lay-shaft and first motion shafts (as is done frequently with the vertical drive shafts of our o.h.c. engines). However, I found this to be difficult, requiring either the lay-shaft train to be bored out or for a new thinner lay-shaft spindle to be made. I do not favour either of these options. I have now managed to find suitable bearings although without an inner sleeve, so that the needle rollers run directly on the hardened and ground existing lay-shaft spindle. These bearings have an o.d. of 13/16ths of an inch but a hardened and ground outer sleeve to make up the extra 3/16ths of an inch is easily obtainable. I bought the required parts from Simply Bearings, but I have no doubt that they are obtainable from other bearing stockists. The needle roller bearing is BA.108.ZOH which is a high quality Japanese drawn cup high speed (maximum 25000 r.p.m.) bearing, hardened and ground and fitted with a full complement of needle rollers. The o.d. is 13/16ths of an inch and they are 0.495" long, so two can be fitted at either end of the lay-shaft spindle and a further two inside the first motion shaft spigot. The price? Under £3 each! How anyone can make such a lovely little piece of kit for that price baffles me completely. The outer sleeve to take up the required 3/16" of an inch is IRB.1316 – again hardened and ground and the cost is about £5 each but as they are 1.008" in length you only need three of them whereas you need six of the BA.108.ZOH bearings. The nice thing about this conversion is that no special machining is required, and if you do not like the conversion (although I can't imagine why anyone would not) everything is easily reversible.

As you will know, when the "Hyatt" type bearings are used, it is important to include a pair of hardened steel thrust washers (known as beveled bearing washers) at either end of the bearings to minimize rubbing contact between the bearing and the gear case, as the "Hyatt" bearings are free to move inside the bore of the lay-shaft train. I don't think that these beveled bearing washers are necessary with the new drawn cup bearings as the profile of the drawn cup prevents any risk of the needle rollers coming into contact with the gear case or with any gears which might be rotating at a different speed. However, a trial fit showed that there is ample room to include the beveled bearing washers and consequently "to be on the safe side" I have included them. As with the "Hyatts", the larger diameter of the thrust face faces away from the bearing itself.

The length of the original "Hyatt" type bearings is 0.945" or thereabouts (it seems to vary a bit from one bearing to another - which doesn't really surprise me) whilst the length of two new BA.108.ZOH bearings is 0.990". I was reluctant to stray too far from the original dimensions, so I rubbed down one end of each of the three IRB.1316 sleeves using fine grit wet and dry paper on a flat surface (such as a piece of plate glass) to remove the unwanted 18 thou so that the overall length of the sleeve is reduced to 0.990". Next find a longish 3/8th" bolt

(preferably BSF of course!) and a selection of 3/8ths" washers. Make sure that the outside surface of the bearing and the inside of the sleeve are perfectly clean and lightly oil both. Assemble the sleeve and bearing with the bolt, washer and nut and tighten the nut until the bearing is pressed into the sleeve. Continue tightening the nut until the bearing is fully inside the sleeve, then remove the nut and press the second bearing into the opposite end of the sleeve. While you are in the mood, you might as well load the other four bearings into the two remaining sleeves.

Next take the lay-shaft train and insert one of the beveled bearing washers (larger bearing surface facing inside the train.) This won't pass all the way through due to the thicker section in the centre of the spindle. Line up one of the sleeves with its two bearings, insert the long bolt, washers and nut and tighten the nut until the sleeve/bearing combination is pressed fully into the lay-shaft train. Then select a slightly smaller washer which can actually pass into the bore of the lay-shaft train and continue tightening until the sleeve/bearing combination is pressed further in for 0.160", to allow for the second beveled bearing washer to be inserted when final assembly takes place. The aim is for the beveled washer to be completely flush with the end of the lay-shaft train when it is eventually assembled.

When rebuilding my gearbox I decided to fit a brand new lay-shaft train (which comes with a new first/second speed cog) and a new lay-shaft spindle and I found that the fit of the sleeve/bearing combination into the bore of the new lay-shaft train was very firm. This is fine as I did not want any chance of the sleeve/bearing combination moving inside the lay-shaft bore. As an experiment, I fitted one of the sleeve/bearings into a pair of original (possibly 80 year old) lay-shaft trains I have in my spares box and found that it could be pressed in quite easily by hand. If you are using an original lay-shaft train, I recommend that a few dobs of Removeable Loctite are put onto the sleeve to make certain that it will stay put inside the lay-shaft train.

When the sleeve/bearing combination has been pressed into one end of the lay-shaft train, insert the lay-shaft spindle through from the opposite end making sure that the end of the spindle with the hole cross-drilled through it is at the opposite end to the double-helical gears and put a second beveled bearing washer on the spindle and push it in as far as it will go into the lay-shaft train. You cannot use the "long bolt and nut" method to press in the second of the sleeve/bearing combinations and it will be necessary for you to devise an alternative method of pressing it into the lay-shaft train. I used a three leg puller which worked nicely, but a large vise or woodworking cramp would do just as well (or better still a hydraulic press, if you have one !). Remember to press the sleeve in for a further 0.160" to make room for the outer beveled bearing washer when final assembly takes place. At this stage a trial fit of the entire lay-shaft spindle (with the beveled bearing washers in place on either end) is probably a good idea. Slide the lay-shaft train and spindle into the bottom of the gearbox until the sliding third speed double helical gears are lined up to engage properly with the corresponding gears on the

main-shaft and then raise the spindle until the rear end can be pushed into the hole in the end plate of the box. Tap the spindle until the back end emerges out of the of the end plate and then turn the spindle until the cross-drilling can be seen through the threaded hole underneath the rear housing. You can now be sure that the lay-shaft is lying in its correct position. Hold the spindle in position and check the movement of the lay-shaft train fore and aft on the spindle. There should be about 3/16ths of an inch or thereabouts, movement visible. The precise amount of movement is not critical, as the final positioning will be determined only when the first motion shaft is eventually engaged and tightened up. Next place a straightedge across the front face of the open gearcase and check to make sure that there is clearance between this face and the beveled bearing washer in the end of the lay-shaft. At this stage, put a dob of white paint on the rear end of the spindle to indicate where the cross-drilling is, so that you can make sure that the drilling can be accessed easily during final assembly.

We are now getting to the final stage of this saga. The conventional method of joining the bell housing and gearbox together is to place the bell housing (with the first motion shaft and main bearing already installed) on the bench and to lower the gearbox onto it at a slight angle and "jiggle it about a bit" until everything falls into place. This method relies heavily on the inbuilt "sloppiness" present with "Hyatt" type bearings, and with the new needle roller bearings I found it impossible to use the old system as the new needle rollers run straight and true with much greater accuracy than the original "Hyatts". It is therefore necessary to develop a different method of joining the two parts together. First, remove the first motion shaft with its main bearing and bearing retaining plate (the bit with the four ¼" b.s.f. bolts sticking out of it) from the bell housing and place it on the main shaft (first checking that one of the beveled bearing washers is in place on the main shaft.) It might be necessary to select third gear (to bring the third speed cog forwards) and to tap the lay-shaft spindle forwards half an inch to get the double helical gears to mesh. The bearing retaining plate with its four bolts should now be hard up against the main bearing (which should of course be one with a single seal – the seal on the flywheel side of the bearing.) When the first motion shaft is properly engaged, tap the lay-shaft spindle back until it is about to emerge from the gearbox rear plate and using the dob of white paint to guide you turn the spindle until the cross-drilling can be seen through the threaded hole on the underside of the rear plate. You can now insert the special bolt with its reduced end diameter to locate in the cross-drilling and tighten it up appropriately.

Now, stand the bell-housing up vertically on the bench and mount the gearcase on suitable blocks of wood so that the first motion shaft is lined up ready to pass though the hole where the main shaft bearing will fit. Ensure that the bearing retaining plate with its four ¼" b.s.f. bolts is standing vertical (it has a nasty habit of slewing off vertical and jamming against the top gear cog) and bring the gearcase and bell-housing together gently so that the main bearing is about to enter the hole in the bell-housing. Using a pair of thin screwdrivers or rods (such as cycle spokes) ensure that the bearing retaining plate stays vertical and encourage all four ¼" b.s.f. bolts to enter their respective holes. You might need to tap the gear case or the bell-housing with a soft faced mallet to assist the main shaft bearing to pass into the bell housing,

and quite soon the four b.s.f. bolts will start to emerge from the holes in the clutch side of the bell-housing. As soon as you can, screw the ¼" b.s.f. nuts onto the bolts and tighten them diagonally one turn at a time, to make sure that the bearing retaining plate stays vertical, thus drawing the main shaft bearing into its final position in the bell housing. The ¼" b.s.f. bolts have only a short length of thread and therefore you will need to remove the nuts from time to time to pack the bolts out with washers or slightly larger nuts to enable the ¼" nuts to continue being tightened. While all of this is going on, the six 5/16" b.s.f. studs (actually one of my gearboxes has the six studs replaced by individual bolts) sticking out of the clutch end of the gear case, will start to engage with the six holes in the bell-housing. When you can, screw nuts onto the studs, (or get the separate bolts to engage with the gear case) and continue tightening these and the ¼" b.s.f. bolts fixed to the bearing retaining plate so that the main shaft bearing continues its journey into the bell-housing. Before the gap between the gear case and the bell-housing disappears completely you can introduce a small bead of your preferred sealant all around the two faces (only the thinnest of wipes is needed).

Continue tightening both the six 5/16ths and the four ¼" nuts a little at a time until the gearcase and the bell-housing are completely closed up together and you can then remove the extra washers and nuts from the four ¼" bolts. Before installing the small aluminium cover it is worth putting a thin smear of engineer's blue to the face of the cover, bolting it up tight and then removing it again to see how well the cover fits in relation to the face of the bell housing. The cover should contact the exposed end of the main-shaft bearing so that the bearing is securely locked in place. If any doubts exist, cut a circular shim out of 10 thou shim brass the same diameter as the exposed bearing, which should take up any unwanted clearance.

On the question of sealing to prevent leakage of gear oil, this should not be necessary if you are using a new sealed main shaft bearing, but a thin wipe of sealant round the edge of the small aluminium cover is a useful "belt and braces" feature. It is still necessary to seal the exposed end of the lay-shaft spindle where it protrudes through the bell-housing and I use a suitable size "O" ring plus a bit of sealant before covering the exposed end with the special dished washer, "y" shaped locking plate and bolt.

I should mention that when I was carefully tightening the bolts to draw the bell-housing and main- shaft bearing together, I checked two or three times to see whether I could turn the first motion shaft and I found to my consternation that I could not move it. I continued to tighten everything up and found that when it was all tight I could spin the shaft and all gears very freely. I suspect that during the tightening process, the retaining plate with its four ¼" b.s.f. bolts had moved very slightly out of the vertical and I presume that the bolt heads were fouling the double helical gear on the first motion shaft. It clearly shows how little room there is inside the gear box.

I am sorry that this is so “wordy”, but I am a great believer in using ten words when only one will do. Since doing this conversion on BGH 295 I am really delighted with the smoothness of the box and I have now completed 1200 miles of use including running in The Kimber Trial. Apart from the smoothness, it is noticeable that after a number of brisk runs of over 60 mph, the box is only just warm to the touch, whereas in the old “Hyatt” days, it would have been almost too hot to touch.

Colin Butchers. April 2019.