TECHNICAL NOTES SERIES

JOWETT JAVELIN – PA, PB, PC, PD & PE
JOWETT JUPITER – SA & SC

– PART XIX –

ENGINE FLYWHEEL REPAIR TECHNIQUES

Compiled by Mike Allfrey – 26th February, 2017.

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SECTION 1.

FROM THE MAINTENANCE MANUAL

Below, is the text from the Maintenance Manual for the 1½ Litre Jowett Javelin and Jupiter, published by Jowett Cars Limited. This has been placed here for the purpose of informing how the starter ring-gear should be installed on to the flywheel, along with other flywheel data.

Flywheel

The flywheel dowel, the chamfered end of which is fitted into the crankshaft, should be an interference fit in the crankshaft drilling, and a good fit in the flywheel.

The crankshaft spigot should be clean and free from burrs, and should fit snugly into the recess in the flywheel. Particular attention should be given to the rear face of the crankshaft and to the face of the recess in the flywheel, the depth of which should be ⅛" (3 mm).

These faces must not be damaged in any way and action must be taken to rectify any injury before finally fitting the flywheel. The setscrews must be tightened down evenly over shake-proof washers by diagonal selection, using a torque wrench set to 60 lbs.-ft. (8.292 M.-kg).

The maximum permissible run out for the flywheel rear face is 0.003" (0.076 mm), this may be checked using a dial indicator mounted on the clutch housing. Should the limit be exceeded it is probable that dirt or burrs are preventing the even seating of the flywheel on the crank spigot.

Service ring-gears, specially heat treated, and ready for shrinking on the flywheel, can be supplied. To remove the existing gear, split with a cold chisel, taking care to avoid damage to the machined face of the flywheel. Heat the replacement evenly to a temperature of 260°–320 °C. (colour changing from deep straw to purple) and maintain this temperature for two minutes.

Drop the gear into position on the flywheel, with the chamfered side of the teeth downward, tapping with a copper hammer if necessary, and allow to cool in air.

Note: It is most important that the flywheel ring-gear is not heated to more than 320 °C, as the temper will be affected if this occurs.

If no temperature gauge is available, a heat sensitive pencil, for the correct temperature range should be used; this can be supplied with the ring.

Writer's Note

Prior to removing the ring-gear in the manner described above, try removing it by mounting the flywheel assembly on suitable hardwood blocks, on a solid bench surface, with the clutch face down. Use a heavy hammer and a brass drift to push the ring-gear off the flywheel. If it is a loose fit, the gear will come off the flywheel easily.

Should this be the case, then serious consideration must be given to mount the ring-gear using the method described hereafter in these notes. Alternatively, have a machine shop measure the land on the flywheel diameter and the inside diameter of the ring-gear. Then, consider the advice given for a shrink-on fit assembly procedure described above in the Maintenance Manual.

SECTION 2.

Diagnosing A Loose Ring-gear Concern

Note: The terms left, right, front, rear, forwards and rearwards should be observed as when sitting in the driver's seat and looking forward.

There can be instances where a Javelin or Jupiter starter motor's bendix may not engage with the starter ring-gear and this condition may not be related to the starter motor's operation. There have been numerous instances where the starter ring-gear has moved on the flywheel's diameter to the extent where the motor's Bendix may not mesh with the ring-gear.

This concern can reveal itself in two ways:

1. On pressing the starter button, the starter motor emits a loud high-pitched clattering sound made by the bendix pinion not fully engaging with the flywheel ring-gear.
2. The starter motor emits a free-spinning sound, that from within the car can sound like a muted buzzing noise.

Both of these revelations are the realisation that the ring-gear could have moved rearwards off its flywheel rebate and indicate that investigation is required.

First, it should be explained that the design of the flywheel is different from what is seen as being 'normal'. The machined rebate on the flywheel is positioned with its land for the ring-gear to mount against being on the front face of the flywheel's outer diameter. In addition to this, the starter motor is mounted over the flywheel housing and the gearbox. This is the Jowett method of mounting the starter motor, what is considered to be the 'normal' position of the starter motor, within most of the British motor industry, is to have the starter motor's body tucked in alongside an engine's cylinder block.

We need to examine the reasons for the reverse mounting of the starter motor and the 'conventional' fitting of the starter ring-gear. The first reason is, obviously, because of the engine's horizontally-opposed cylinders layout, it was not practical to position the starter motor over the top of the engine due to the position of the cooling fan and other ancillaries. In addition to that, it would have been expensive to have a starter motor manufactured by Lucas to only suit the Jowett installation. Therefore, with the starter motor in position, and due to the starter's standard shaft length, the ring-gear (with due consideration given to the positions of the clutch assembly and the gearbox's first motion shaft) had to be placed on the rear face of the flywheel. Thus, with correct fit machining tolerances, the Jowett design will, definitely, work.

In effect, the starter motor, when the bendix engages with the ring-gear, it has a 'knocking the gear off the flywheel' action. There is nothing wrong with the Jowett design, provided that the diameter tolerances are correct and that the ring gear is properly installed. There is also the possibility that locally (Australia) manufactured ring-gears may have been machined, inadvertently, out of tolerance at the gear's inside diameter. This could result in a snug, rather than tight fit after installation on the flywheel. There is also the possibility that, at the time the flywheel was machined, diameter tolerances were not

maintained strongly enough. Another cause of a loose-fitting ring-gear to flywheel concern can be due to over-heating the ring-gear prior to installation on the flywheel.

Extreme care needs to be observed, because some manufacturers do recommend that a ring-gear be heated until it glows red, installed and then quenched with cold water to shrink and temper the gear. With regard to the Jowett, the procedure described in the Maintenance Manual must be followed – to the letter.

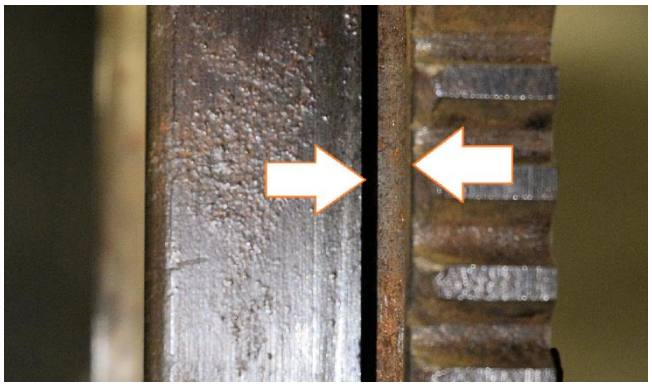

Figure 1. Close up of a ring-gear that has moved on the flywheel. The amount moved indicates that the starter pinion would not mesh in a positive manner.

The simplest method of diagnosing a loose ring-gear is to shine a small torch into the flywheel position window in the top of the flywheel housing. This is where the top dead centre position of the crankshaft is observed when setting valve and ignition timing on the engine.

Because of lighting conditions, it may be difficult to see the gap between the rebate face and the ring gear. A small, flat bladed screwdriver can be used to feel if the ring-gear has moved rearwards, by sliding the tip down the front face of the gear and, once against the outer diameter of the flywheel, slide the screwdriver's tip forwards to feel the gap between the gear and the rebate.

With some practice, it is easy to determine how far the gear has moved.

SECTION 3.

Repair Options

Once it has been determined that the ring-gear has moved on the flywheel, there are choices of repair methods available to choose from.

1. Scotch key method. This is, very likely, the most effective method of making a lasting repair. This method will be described in detail in these notes.
2. Chemical bonding method, If carried out in the correct manner, can be successful. It can also be used as an in-car repair.

   There are a number of Loctite products that can be used successfully. The writer has used Loctite 471 primer-surfacer to prepare for a Loctite 680 bearing retention adhesive to secure tractor ring-gears, in the situation where a new ring-gear would have been a loose fit. This repair has to be carried out quickly and certainly to ensure that the front face of the gear is hard against the land on the flywheel. Loctite 680 can, under some conditions, cure in a very short time and, once cured with the ring-gear not properly seated can cause it to be extremely difficult to remove and clean up.
3. Stitch welding. This can also be carried out *in situ* but is not a satisfactory repair, and cannot be used with any confidence. A weld repair with four or six short stitches of electric welding at the rear face of the flywheel can be very tempting.

   The illustration below shows a failed stitch-welded repair and highlights how unsightly such a repair can be, particularly when welds have broken away from the parent metal (flywheel).

Figure 2. A graphic illustration showing how a loose ring-gear should not be repaired.

Figure 3. A close-up of a broken electric welding 'repair'.

Nonetheless, two dissimilar metals, cast iron at the flywheel and tempered steel used for the ring-gear, mean that the weld will, predictably, break away from the flywheel. Such welding can crack while it is still cooling after the welding operation. Also, such a repair can be very unsightly and, quite easily, can cause an imbalance concern that would be very expensive to repair.

SECTION 4.

Engine Removal Preparation

Place the car on a level concrete surface, apply the hand brake and jack up and lower onto four support stands. Make sure that there is sufficient room on the floor for

wheeling the engine and gearbox out of the car. The supported height should be convenient for working under to remove Layrub coupling bolts etc.

Repair Preparation

With the engine and gearbox assembly mounted on a free-standing work bench, take the following steps:

1. Cover the carburettor intakes to prevent dust and dirt ingress.
2. Remove the four sparking plugs and cover the cylinder heads. This action will make the crankshaft easier to rotate while the repair is in progress.
3. Drain the oil from the gearbox.
4. Remove the lower flywheel cover. Remove the starter motor.
5. Unscrew the four gearbox securing nuts.
6. Use a suitable extension lever to pull the clutch throw-out lever rearwards, to separate the gear-box from the flywheel housing. Be sure to support the clutch throw-out fork and bearing while the gearbox is withdrawn. Place the gearbox so that it is well supported and residual oil can drip into a tray.
7. With the clutch throw-out support, fork and bearing removed, loosen the clutch housing setscrews to withdraw the clutch assembly and the friction disc.

   Note: There could be a situation such that the ring-gear has dislodged on the flywheel to the extent that it prevents the crankshaft from being rotated. Should this be the case, gently with a heavy hammer and a brass drift (punch) tap the ring-gear home on the flywheel progressively as the crank-shaft is rotated. The ring-gear can be tapped forwards through the starter motor opening, and at the open sector below the flywheel housing.

   This 'repositioning' of the starter ring-gear can greatly assist with the withdrawal of the flywheel assembly, should the gear have moved up to 5 mm rearwards. The assembly is a surprisingly snug fit in the housing.
8. Using a piece of old ring-gear as a wedge at the lower right hand side of the housing, and using a 7/16" Whitworth socket, unscrew the flywheel retaining bolts. With these bolts removed, there are two ⅜" Whitworth threaded holes into which can be screwed setscrews to push the flywheel off the crankshaft spigot. This is a safer and easier method of flywheel withdrawal than using levers.
9. With the flywheel removed and placed on a work bench preparation can begin on the repair.

SECTION 5.

Carrying Out The Repair

Purchase four (4) countersunk 8 mm diameter setscrews that are 20 mm long (overall).

1. Ensure that there are no burrs or places where the ring-gear may have 'picked up' on the flywheel diameter, that could prevent the gear being set in its home position. Both components must be thoroughly cleaned before the loose ring-rear is clamped in place.

   Note: if the ring-gear's teeth are worn at one point, where the engine frequently stops on a certain compression stroke, the ring-gear can then be positioned so that the bendix engages on a different sector of the gear.

Figure 4. How the marking out commenced with the 1 and 2 TDC mark carried through to the clutch face.

Figure 5. Detail of the carried through marking shown in white for clarity. Also visible are the spot facing of the fly-wheel and the countersunk setscrew face above the ring-gear face. Camera angle distorts the image.

2. Note, on the flywheel rim, the position for '1↑2' cylinders' TDC point. Exactly, carry that marking through to the clutch face of the flywheel.

   With this mark made, measure a point 80° anti-clockwise (facing the clutch side of the flywheel). Mark here the position of the first countersunk setscrew, to centralise the thread hole at midpoint between the ring-gear and the flywheel.
3. Arrange for a machine shop to set up the flywheel assembly in a three-jaw chuck, securely mounted on a suitable milling machine's work table. The mill should then be set up so that the protruding flywheel face can be spot faced flush with the ring-gear, at the 80° marking to facilitate drilling the thread tapping size hole (6.8 mm dia.). Next, each 90° around the inner diameter of the ring-gear, spot face the other three faces accurately in the same manner.

While drilling the 6.8 mm ($^{17}/_{64}$") diameter holes in the flywheel it will need to be supported from the underside to the table's face with a threaded support jack post, while the holes are being drilled.

The use of a mill ensures that the four threaded holes are drilled to the same depth to maintain the flywheel's balance with the crankshaft.

Once the first hole is drilled to the depth of 22.5 mm, from the face of the ring-gear, rotate the flywheel 180°, clamp in place and drill the second hole. Next, rotate the flywheel 90° and drill the third hole, then rotate the flywheel 180° to drill the fourth hole. The holes should not break through the front face of the flywheel.

There must be 90° between each hole.

4. All four holes should then be tapped with an 8 mm with 1.25 mm thread pitch tap, finishing carefully with a bottoming tap.

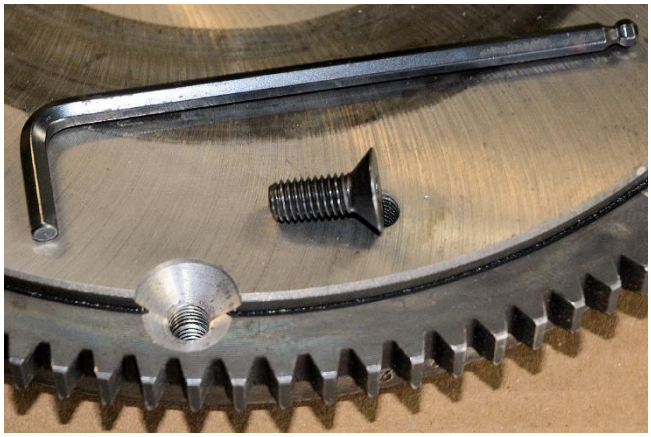

Figure 6. Showing the spot facing so that drill can start the hole at centre between ring-gear and flywheel. Also shown is extent of counter sink machining. The countersunk setscrew is 8 mm thread diameter with 20 mm overall length. A very good illustration of the 'scotch-key' method of securing the ring-gear.

5. With the flywheel still held in the chuck, and also supported under the tapped out holes, countersink the holes to the extent that, when the screws are tightened home, they protrude 1 mm above the rear face of the ring-gear.
6. In following these instructions, the machinist has drilled and tapped the retaining screw holes half in the flywheel and the other half of each hole in the ring-gear. This means that the gear is scotch-keyed in place by the setscrews' thread diameter to prevent the ring-gear from rotating on the flywheel. The fact that the thread is centred at the contact point between the ring-gear and the flywheel means that the screw threads will prevent any rearward movement of an errant ring-gear. This retention is reinforced by the heads of the countersunk screws overlapping the ring-gear.
7. As a final precaution a drop of Loctite 262 Studloc or Loctite 680 bearing retainer can be applied to the counter sink faces prior to tightening the screws. Use an anti-seize compound on threads. Wipe away any surplus Loctite that may be forced out as the screws are tightened. To facilitate screw removal, gently heat the screws to loosen off.

The flywheel can be lightly oiled to prevent rust, but not on the clutch disc facing contact area. To prevent lining material adhesion, clean the face of the flywheel with Brasso and polish off. This will be scuffed off when the clutch is slipped briefly.

Reassembly

As described in the Jowett Maintenance Manual, the rear face of the crankshaft must be absolutely flat, as must be the counter bore in the front of the flywheel. There must not be any burrs on the crankshaft spigot where the flywheel is fitted. Rotate the crankshaft so that the dowel is at its bottom dead centre position, prior to fitting the flywheel on the crankshaft spigot. Line up the locating dowel and the four securing bolt holes. Ease the flywheel forward and, once properly located, install the four ½" bolts with a set of new internal-tooth lock-washers.

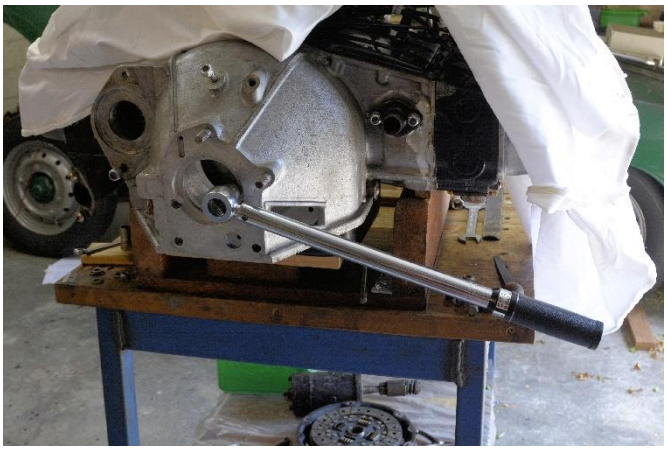

Figure 6. Tightening the flywheel bolts.

Tighten evenly to 60 lb. ft. (81.3 Nm) torque, again using a segment of old ring-gear, but this tine inserted at the lower left hand side of the clutch housing, to firmly wedge the flywheel while the bolts are being tightened.

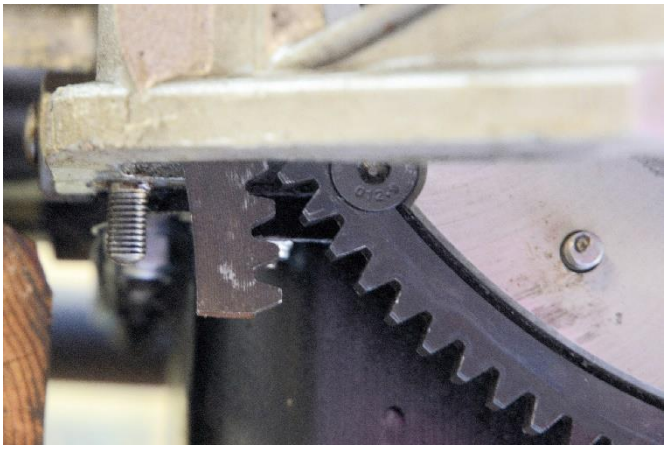

Figure 7. Using a piece of old ring-gear as a wedge to hold the flywheel during bolt tightening.

Install the clutch housing and friction disc assembly onto the flywheel, noting the positions of the two locating dowels. Insert the clutch throw-out bearing support and, using a spare first-motion shaft as a guide to centre the friction disc with the bushing in the crankshaft, install the clutch assembly over the dowels. Tighten home the six clutch securing bolts. Withdraw the first-motion shaft and lightly lubricate the clutch throw-out fork's pivot ball and the support for the throw-out bearing's hub to slide on.

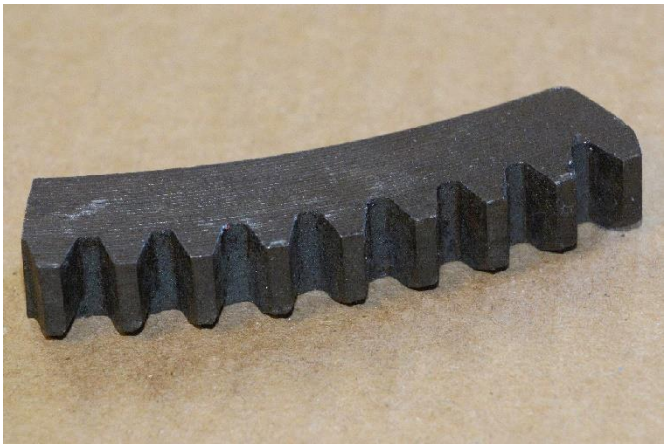

Figure 8. The piece of ring-gear for use as a wedge.

Install the four components that make up the clutch operating mechanism and, once in place, make sure that the notch in the support aligns with the right hand hole in the housing. Left hand drive cars employ the other hole.

The front face of the gearbox and the rear face of the flywheel housing must be thoroughly cleaned and wiped finally with methylated spirits. Apply a minimal film of Loctite 515 Master Gasket sealant to both faces of a new gasket. Apply a smear of white zinc oxide grease to both the front spigot and the spline that engages the friction disc, keep the grease quantity minimal.

In the gearbox, select top gear and, as the first-motion shaft is aligned with the female spline in the disc hub, rotate the rear coupling flange till the shaft enters the disc spline and the gearbox can be slid fully forward. Install plain washers and new Simmons nuts (Nyloc). The nuts should be evenly tightened dead tight. Wipe off excess sealant with a cloth moistened with methylated spirits and leave to cure.

SECTION 6.

Installing The Engine And Gearbox

Essentially, this is the reverse of the procedure described for the engine/gearbox assembly's removal. The Layrub coupling bolts must be tightened so that the split pin groove in the nut aligns perfectly with the drilling in the bolt. Do not back-off the nut to achieve alignment, tighten it further. Make sure the correct washers are used with these bolts and nuts.

Prepared by Mike Allfrey – 02-2017