Austin Seven Engine
Part 2 - Crankshaft, connecting rods, main bearings and flywheel

This is the second in a series of A7 engine re-build articles. Part 1 appeared in the November 2018 HA7C newsletter *Crankhandle* and dealt with the preparation of the crankcase. Please bear-in-mind that these notes are definitely not an attempt to say *'this is what should be done'*, they are simply an account of what I do.

Crankshaft
If you drive your A7 like a nervous granny, or the engine is to be used simply as a spare, then I believe it is perfectly feasible to retain an original Austin crankshaft, so-long as it has been carefully crack tested and found to be sound. A common area to find cracks on two-bearing crankshafts is the rear web just behind number four big-end journal but they can also crack on the journals and elsewhere. However, if you are inclined to belt along and rev the engine enthusiastically in the gears and/or seek an especially high level of reliability from your bottom end, then a modern replacement crankshaft is probably a good idea. This is simply because 'two-bearing' crankshafts tend to flex when revved hard (i.e. go round like a skipping rope) and this can (and probably 'will') eventually lead to a broken crank' through 'fatigue' failure. Many original Austin cranks have been whizzing around for eighty or ninety years now, so it is mind boggling to think how many times they may have already flexed. You might be lucky enough to have a sound Austin crank that doesn't need regrinding together with four beautifully matching conrods and I can understand the temptation to re-utilise these items. However, if the big-end journals (sometimes referred-to as crank pins) need regrinding and consequently the conrods need re-metalling, then this significant cost might be better spent as a contribution towards a modern crank.

The only modern crankshafts of which I have personal experience, are the $1^5/_{16}$" splash-feed ones made by Phoenix Engineering and I have found them to be perfectly satisfactory in service. My only note of caution is that my first brand-new Phoenix crank' was supplied with one big-end journal 10 thou' undersize. Happily, the item was immediately replaced without any quibble and subsequent ones have been spot-on, but nowadays I always check. Interestingly, I recently checked the big end journals on my original Phoenix crank' after it had propelled a variety of A7s fairly enthusiastically for more than 20,000 miles and there was no measurable wear whatsoever.

So how do we measure big end journals? Well, when new or reground, the business part of a journal will start life as a precision cylinder, i.e. sides exactly parallel and constant diameter wherever measured. However, during its working life it will inevitably wear and because the heavy firing stroke load from the piston/conrod is applied to a particular side of the journal every other rotation - this will eventually cause some ovality. Similarly, any longitudinal flexing of the crankshaft can cause journals to wear in a conical manner. Therefore, to obtain a complete picture, we must measure the diameter of each big-end journal at six different positions. Firstly, a reading at each end (inboard of the fillet radius) and one in the middle, with the measurements taken at the same angle as the firing stroke load; then a second set of readings at right angles to the first three. The difference between the pairs of readings will reveal any ovality of the journal at each position and it is the maximum ovality that is of interest. Next, the difference between corresponding readings at either end of the journal will show the extent of any taper. Finally, a comparison of the end and middle readings will determine the extent of any 'barrelling'.

An ideal big-end diametric clearance for a splash feed two bearing A7 engine is probably one or two thou'. This is where a conrod lubricated with very thin oil, will fairly easily fall under its own weight with the big-end bolts fully tightened. This suggests to me that an ovality of up to three thou', and a similar amount of end to end taper or barrel shape can all be regarded as perfectly allowable tolerances without having to re-grind the crankshaft. Remember, whilst it may not be frighteningly expensive to have a crankshaft reground - the cost of the necessary conrod big-end white-metaling is considerable and several firms nowadays are quoting lead-times of three or four months.

Earlier, I mentioned 'crack testing' and I use the Johnson and Allen two part aerosol 'magnetic ink' method which is straightforward and seems to work well. It is used in the nuclear industry and by the military so, it should be OK for Austin Sevens! After thoroughly cleaning, polishing (with emery cloth) and degreasing the relevant areas, the Neopaint NPT16 'contrast aid' white is applied and allowed to dry, which takes only a minute or two in a warm cosy workshop. Next, thoroughly agitate the black Neocol B black magnetic ink aerosol to ensure full dispersion of the magnetic particles in suspension and magnetise the item to be tested. I do this by holding a powerful magnet against the back of the area of interest with a sheet of paper in-between, to prevent spraying the magnet and don't forget to keep powerful magnets well away from your pacemaker! Finally, the magnetic ink is sprayed onto the component surface and a careful visual inspection in good light will reveal the presence of any crack, as a discernible black line. This method is applicable for crack testing many other ferrous components including A7 conrods and will be referred to again in the next section. Obviously, if a crack is detected, then the crank' should no-longer be considered suitable for use.

Conrods

If money is no object or you are building a racing engine, then I imagine it might be nice to have brand new conrods and several different manufacturers now offer suitable rods for our engines. However, I took expert advice some years ago that recommended sticking with Austin rods for road use (including enthusiastic use) so long as they have been carefully selected and equalised. My experience suggests this advice was sound because I have not yet broken a conrod and many of the failed ones I have seen were damaged for other reasons such as crankshaft failure or piston breakage. Interestingly, I have seen terribly damaged A7 engines where the conrods have bent but not broken which might suggest they might be stronger than they look.

So how do I select conrods? I firstly check the fit of a new gudgeon pin in the little-end, it *must* be a firm push fit with absolutely no slackness, then check that the little-end pinch bolt thread is sound. In my view, these checks are of the utmost importance because I have seen several engines where poorly fitting gudgeon pins have caused considerable fretting to the securing bolt. If this is left unattended, the engine is almost certainly doomed to failure. I always use new HT bolts on assembly with internal shake-proof washers and a touch of thread-lock - all tightened very firmly (this will be covered in a future article).

I also file smooth and polish any potential stress raising marks on the flanks paying particular attention to the top of the web just below the little-end where many rods can be found to have cracks. The rods are then crack tested in this area using the Johnson and Allen two part aerosol 'magnetic ink' method described earlier.

Readers with an excellent memory, will recall the January 2014 Newsletter article containing a photo showing how A7 con-rods can be simply checked for fore and aft bending or twist, by passing a length of 0.500” diameter ground Silver Steel through all four little ends with the rods firmly attached to the crankshaft. For new members and those with an imperfect memory, we have a similar photo here. The rod should be a firm sliding/twisting fit without any binding or loose play.

Some time ago, our Technical Advisor Eddie acquired a proper tool for checking the truth of con-rods and it is shown in the photo on the right being used to check the rods for an engine that I was building at the time. This delightful bench mounted machine is beautifully made of cast iron and reassuringly heavy - it would make a brilliant household ornament! The design is based on a precision expanding mandrel holding the big-end bore, whilst a rocking stirrup is brought into contact with the firmly clamped gudgeon pin protruding either side of the little-end, so that a pointer accurately registers the pin’s position over a fine scale. The rod being examined is mounted as described and the pointer position noted. The rod is then reversed and if the pointer returns to the same place, then the bores of the big and little ends are truly parallel with one another.

Eddie assures me that slightly bent rods can be straightened satisfactorily. Very slight adjustments by cold twisting or bending are considered permissible. Usefully, the Dorset A7 Club website Technical Pages show how rods can be straightened using a vice as a press.

A later article will discuss engine assembly in detail but it is perhaps useful here to mention that I favour being able to pass the conrods down the bores. This usually necessitates filing away the ‘bumps’ either side of the conrod big-ends if the bores are smaller than +60. This filing can often usefully be incorporated in the process of equalising the weights of the four rods. At this stage, it is also useful to ensure the big-end rods and caps are permanently marked to ensure correct positioning on re-assembly.

Fitting conrods to crank’ journals is straightforward in an existing engine where the journals are within limits and the white metal in the big-ends is sound. After thorough cleaning and careful inspection of the white-metal for cracks or other damage, the rods should be clamped in position on the crankshaft after lubricating the journals with light oil. I keep a set of old Nyloc nuts for this purpose and save a set of new ones for final assembly. Interestingly, it appears there are two different depths of 5/16” Nyloc nuts on the market and I prefer the slightly deeper ones because a socket fits more securely without binding on the cap. So, after torqueing the nuts to the required 18 lb ft and rotating the rod a few times to disperse the oil, check that the rod will happily fall from the horizontal under its own weight but without undue radial slackness. Slight (around $^{1}/_{16}$”) fore & aft (rocking) play at the little-end is OK in my view. If the rod seems just a little too slack, it can be dismantled and the big-end mating surfaces rubbed on fine wet & dry paper supported on a truly flat surface, then cleaned and reassembled. Finally, give the big-end cap a reasonable thump via a stout brass drift and you might find this results in a better journal fit. If the big-end still seems slack the process can be repeated.

On the other hand, if the journal is a bit too tight, it will be necessary to indulge in the ‘dark-art’ of bearing scraping. I say this, because having discussed the subject over the years with a number of experienced practitioners, I have come to the conclusion that there are several different approaches. Anyway, the method I use (which happily seems to work) is as follows …

1. Prepare a 'jig shaft', ground to the required journal diameter plus the required bearing clearance. In our case say plus one to one and a half thou' on diameter. Note: if you use the crank journal directly instead of a jig, you will end-up with insufficient clearance in the finished big-end bearing
2. Coat the jig shaft *very* thinly with engineer's blue
3. Clean the conrod white-metal and bring it firmly into contact with the jig shaft and rotate it gently right around
4. When separated, the high spots on the conrod white-metal will be marked grey/blue
5. Use a sharp scraper to carefully remove these high spots, scraping alternately at plus and minus 45° to the centreline of the bearing journal
6. Repeat from Step No 2 until the blue marking covers more than 75% of the white-metal
7. Repeat the whole marking and scraping exercise for the big-end cap

If the above process has been carefully carried-out and the conrod is cleaned, lubricated and assembled on the crankshaft, it should now happily fall from the horizontal under its own weight.

Alternatively, if we are building an engine with a new conrod/crankshaft combination, then the conrods will have to be white metaled and machined to suit the crankshaft journals. Sadly, the days are gone when every town had its own white-metal business and the relatively small number of remaining providers seem rather expensive. More irritating, is that some outfits now quote lead times of up to four months, which can be very inconvenient. Incidentally, I'm sure readers will recall that the September 2017 issue of this Newsletter contained a useful list of white-metal specialists in the South of England (thank you Ray).

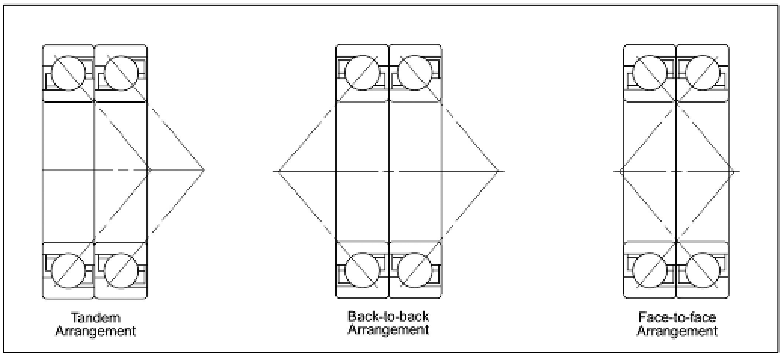
Now, I have known people who have had white-metaling done without specifying exactly what they want. This might be OK if the firm is very well acquainted with Austin Sevens but I always make sure to specify the following ….

- One to one and a half thou' diametric clearance at mid journal
- An extra thou' or so 'bellmouth' at each end of the journal
- Eight to ten thou' longitudinal clearance along the crank journal (Woodrow suggests as much as 60 thou' which seems rather a lot to me)

My approach gives a slightly looser engine than some firms might provide if left to their own devices but is based on advice I received many years ago from a very well respected authority on A7s.

Main bearings
Front – There are two different depths of front main bearing housing in two-bearing coil engine crankcases. Until February 1934, the housing was $1^{39}/_{64}$" deep to accommodate a ball and roller race combination, each $^{13}/_{16}$" thick . Thereafter, the housing was reduced to $1^{35}/_{64}$ to take a pair of slightly narrower angular contact (AC) ball races. I cannot remember the last time I fitted a ball and roller race combination because nowadays, matched pairs of AC bearings are readily available to fit both depths of crankcase housing. The 'angular contact' arrangement is far superior, particularly in its axial load carrying ability which is useful in an A7 to resist clutch loads. New AC bearings are matched pairs and ours being an imperial size, are not cheap but if I have to buy new, then I prefer a known make (such as RHP) rather than the slightly less costly offerings made in China or India. The good news is that pairs of slightly worn AC bearings can be adjusted so long as the balls and tracks are in good condition.

It can sometimes be difficult to tell if an existing bearing is satisfactory for use in a rebuilt engine. Most bearings when thoroughly cleaned in petrol and dried (compressed air is ideal) will rattle alarmingly when rotated and can sound decidedly dodgy. However, it must be remembered that even new ball bearings are designed with some clearance, because a perfect fit would in theory cause line contact between the balls and the track and the thing would struggle to rotate (part of the ball surface would have to slide). A small clearance allows point contact, which enables delightfully uninhibited rotation. So, if the tracks of a perfectly clean bearing appear unmarked (no visual damage or corrosion) they can be sparingly lubricated with very thin oil such as '3-in-one' and rotated slowly whilst applying a variety of axial and radial loads by hand. If any roughness can be felt it means the balls and/or track are damaged and the bearing should be discarded. A7 front main bearings are pretty robust, so, I suspect that any damage is possibly the result of some muscle-bound 'mechanic' fitting or removing them with a large hammer & drift without first warming the crankcase.



Incidentally, matched pairs of AC bearings can be arranged in three different configurations as shown in the diagram. However, we are concerned only with the 'back to back' arrangement which offers good axial and excellent radial load resistance. Just out of interest, 'face to face' is less stiff and would let your crankshaft flex even more than usual and 'tandem' would be only be appropriate if you needed to resist extraordinary high axial loads - quadruple clutch springs anyone? Anyway, for our 'back-to-back' arrangement, the outer race faces that sit together should be marked 'thrust' and you will see that they have a deeper shoulder (in a radial sense) supporting the balls at this interface. Similarly, but in reverse, the inner races each have deeper shoulders at the front and back of the combined pair. In theory, we might expect the inner and outer races to be ground so that their faces are exactly in-line when the balls are at design clearance. However, 'back to back' matched pairs of AC bearings are manufactured so that the mating surfaces of the outer race each protrude by about a thou' compared to the inner. So, when the inner and outer races are clamped in position, the bearings attain the correct pre-load between balls and tracks. This pre-load is carefully designed so that the assembly will comfortably accommodate the prevailing combination of radial and axial operating loads, whilst running smoothly and quietly over a good service life.

OK that's fine for a brand new AC pair but how do we adjust ours if they are a little slack but otherwise in good condition? It is useful here to turn-up a couple of simple buttons that are an easy sliding fit in the bearings with a shoulder to hold the inner races and a pad so that the whole assembly can be clamped in the vice. Mine are in aluminium (easy to turn) but almost any material would do and they are shown in the following photo. Note: the boss on one 'button' protrudes sufficiently to hold the pair in-line.

The bearing assembly is held back to back in the vice by the buttons to ensure the two inner races are pressed firmly together - the clearance between the outer races is then measured with a feeler gauge.

Front AC mains and support buttons

Assembly held for checking pre-load

Adjustment is made, either by inserting a (ring) shim of appropriate thickness between the outer races or grinding the mating faces of both inner races. In either case, adjustment should be carried-out only until the slack is just removed but no more. This is easily tested if using a shim, by clamping the bearings in the vice again (with the shim in position) using the two support 'buttons' and checking that the outers can just about be rotated relative to one another by hand. If grinding the inner races, they can be checked the same way or with a straight-edge and feeler gauge to ensure each outer race protrudes by about a thou'.

Incidentally, A/C bearings can easily be dismantled for cleaning, inspection or grinding, by driving-out the inner race and it is prudent to employ a cloth to catch the balls as they fall-out of the cage. Careful examination will tell you the correct direction to drive the inner race i.e. so that the balls are moved away from the deeper radial shoulders.

If you happen to have a narrow A/C pair in good condition that you wish to use in an earlier deeper crankcase housing, you will need to insert a pair of 1/32" shims to the outer races – one each side of the bearing cluster. This will give the correct 1/64" projection at the front of the housing to make sure the front clamping plate bears on the outer race to prevent the whole lot from moving fore and aft. It also ensures the crankshaft big-end journals correctly line-up with the centres of the cylinder bores.

Rear – The rear main bearing is a simple roller affair that handles radial loads well but offers no resistance to crankshaft axial loads and it seems to attract some bad press with frequent accusations of rumble. New ones seem to have just one or two thou clearance but in my experience, even quite tired ones often don't have a great deal more. It is widely believed that a beautiful new specimen will quickly wear and then go-on for years so long as the engine oil is frequently changed and the car is in regular use. It seems that rear mains can suffer through condensation and subsequent corrosion of the roller tracks if the car spends long periods standing idle and this might be the source of some unwanted noise.

Rear main in its housing

In a nutshell, if the rear main seems rather loose but the tracks are not grooved, then you might be able to mix and match a better combination of parts from your spares box, otherwise a new bearing beckons.

A couple of useful modifications to the rear main bearing housing were mentioned in Part 1 of these notes. Enlarging the oil return hole (both housing and crankcase) to decrease the likelihood of it becoming blocked and two cut-outs to facilitate future outer race removal.

Flywheel

As mentioned in Part 1, there are two possible locations for the starter motor on two bearing A7 coil engines and this means two different flywheels. The early configuration with the starter in the cabin alongside the gearbox incorporated the starter ring-gear on the clutch cover plate whilst later models had the ring gear shrunk onto the front of the flywheel.

Fortunately, Austin Seven flywheels are decidedly robust and seem plentiful, but how do we select a good one? Well, my view is that the taper is of primary importance, because it is absolutely essential that we achieve a good fit on the crankshaft. Flywheels and crankshafts in Austin Sevens occasionally display an uneasy relationship by tending to come loose. Austin may have become aware of this, because whilst the taper in early flywheels took the form of a continuous truncated cone, the later ones had an annular relief half way down the taper which seems to make it easier to achieve a perfect match with the crankshaft taper.

This match is achieved by holding the crank' firmly in the vice (soft metal facings in place please) and coating the taper with a thin film of fine grinding paste, then without the woodruff key – rotate the flywheel a few times whilst applying some pressure to push it onto the crank' taper. If you are lucky, when the taper surfaces are thoroughly cleaned you will see a dull ground area covering the whole contact area. If not, I simply repeat the process until a contact area of at least 80% is achieved.

Whilst we are messing about with grinding paste, it is a good idea at this stage to test the run-out of the flywheel near its rim. Some engine builders accept a run-out of up to fifteen thou' and others don't even bother to check it at all but I like to get it to around five thou' or better, because it all contributes to a smooth running engine and also gives the clutch an easier ride. Checking flywheel run-out is very straightforward once the crank has been installed in the engine but making any

Flywheel taper

Matching crankshaft taper

adjustments with grinding paste so close to the rear main bearing fills me with horror. There are endless alternative approaches but I simply clamp two shallow vee blocks (supported at an appropriate height) on the bed of the vertical milling machine, to support the main bearing journals. A further 'stop' is clamped in position to bear on the front of the crankshaft. The mill table provides an ideal firm flat surface and happily accepts a magnetic mount for the dial gauge. The set-up I use can be seen in the photo ….

Checking flywheel runout

The flywheel is firmly tightened onto the crank' with the woodruff key in position and the assembly is rotated slowly by hand whilst keeping it pushed firmly against the 'stop' clamped at the front end of the crank'. Obviously the face of the flywheel needs to be perfectly clean where the dial gauge runs, nevertheless it is not uncommon to get erratic readings with very slight rotations of the assembly. So, I tend to take an average of several readings close to four (north, south, east & west) positions of the rim.

Incidentally, it is important that the Woodruff key is both a firm (gentle tap) fit in the crankshaft slot and also there is no slack in the flywheel groove. However, it is even more important that when assembled, there is a slight but definite clearance between the top surface of the key and the groove in the flywheel. This can be checked by careful measurement or tested with a small shim. Unwanted interference here has been known to be the cause of loose flywheels.

If any adjustment is required, the flywheel is marked where the run-out is greatest and removed from the crank. Then it's back to the grinding paste but this time, the flywheel rim is rotated back and forth (without the woodruff key) whilst pushing firmly to correct the 'high' area. You need not be too concerned about over-correction, because it takes several minutes to correct a tiny amount of run-out with fine grinding paste. This process of cleaning, tightening and removal with the flywheel puller can be rather time consuming and require multiple iterations. Nevertheless, when friends and family enquire about your flywheel run-out, it is very satisfying to be able to say 'it's negligible'!

Loose A7 flywheels can also be caused by a lack of clearance between the flywheel boss and the centre of the rear main bearing, when fully tightened. This clearance needs to be small enough to nip the oil thrower indents to prevent it rattling around loose but large enough to prevent it being squashed flat. If the indents are completely flattened, the flywheel taper might not fully and firmly engage with the taper on the crankshaft. With the flywheel fully tightened in position, we need an *absolute minimum* clearance of 0.906" this being the depth of the rear main bearing centre race of 0.872" plus the thickness of the fully squashed oil thrower indents of 30 thou' plus a small allowance of say 4 thou. The thickness of new unsquashed indents is typically around 70 thou so the *maximum* clearance we should allow is 0.932", which assumes around 10 thou of squashed oil thrower indents. In the unlikely event the clearance is greater than this, then the thrower indents will need to be enhanced. On the other hand, (and much more likely) if the clearance is too small, then an appropriate amount must be machined from the front of the flywheel boss. I have read a number of articles that glibly suggest mounting A7 flywheels in a lathe and carrying-out such operations but not many of us own a lathe big enough to do this. Never mind, material can easily be end-milled or fly-cut from the front of the boss in a domestic size milling machine with the flywheel clamped flat on the table. This should be followed by lightly dressing the front edge of the boss with a smooth file to remove any roughness.

An oil-tight Austin Seven engine is a thing of great beauty, so I like to pay attention to the oil retention arrangements at the back of the engine. Rather than Sir Herbert's reverse oil scroll groove which in many engines is rather worn, I favour one of the quite reasonably priced modern oil seal plates machined to take a modern lip seal. However, these are only effective if the seal engages correctly on the flywheel boss and the boss itself has a suitably smooth finish. Incidentally, these lip seals are available in either 'touring' or 'high speed' versions and if you are inclined to rev your engine freely – then the later item seems a logical choice. However, these sporty seals are made of 'Viton' and are about three times the price.

The seal position can usually be adjusted a little if necessary by moving it forward or backward in its housing and this is usually sufficient to ensure the seal sits close to the middle of the periphery of the flywheel boss. Next we should examine the finish on the boss itself and if unable to achieve a smooth shine with fine wet & dry, I fit a thin wall sleeve such as an SKF Speedi-Sleeve. Most coil engine flywheel bosses are nominally 1.872" diameter and the appropriate SKF Speedi-Sleeve Stock No is 99188 which has an overall depth of 0.415" and fits diameters of 1.872" to 1.879". These sleeves are easy to fit using the tool supplied but the boss must not have any rough high spots because they would 'show-through' the very thin wall of the sleeve. The following photos show a flywheel boss that needed a sleeve, the sleeve kit, the sleeve knocked in position with the metal 'cup' tool and finally the sleeve in position on the flywheel boss.

The instructions suggest that the sleeve needs no adhesive but I use a touch of 'gentle' Loctite just to make sure it doesn't move. However, if the boss is badly damaged, then I file away any high spots and assemble the sleeve over a thin film of two-part epoxy filler. These sleeves have a flange at the inner end on which the assembly tool engages and this can easily be removed after assembly if required; although, I usually leave it in position because it's not in the way. The key point is that the sleeve should be positioned so that the lip of the seal sits close to its centre.

Earlier, we took a great deal of time and trouble to ensure the flywheel was correctly seated on its taper whilst properly supporting the oil thrower. However, several engine builders have raised the question of whether a thrower is required at all if we are fitting a modern lip seal. The argument being that a modern spring loaded seal should comfortably resist A7 crankcase pressures and might last longer through better lubrication if fully exposed. However, it seems to me that the thrower (which should of course be assembled with the dish side facing away from the engine) tends to fling oil into the seal, so the seal rubbing surface is probably adequately lubricated. Therefore, so far, I have not had the courage to leave-out the thrower but if anyone reading this has already tried – then our Editor would be very pleased to hear from you.

Another flywheel feature worthy of consideration is the condition of the starter ring gear. It has always surprised me how successfully A7 starter motor pinions can engage with quite chewed-up ring gears but if the teeth are really badly damaged, then a new gear is probably required. I have always entrusted ring gear replacement to specialists and the costs have always seemed reasonable. Usefully, new ring gears can often improve the balance of an engine.

It is not uncommon for A7 engines to run perfectly smoothly without ever having been balanced and I imagine this is more likely to be the case if the engine is treated gently. However, if you are inclined to belt your engine, then I believe you are more likely to have a smooth rewarding experience if the rods are carefully equalised and the crankshaft/flywheel/clutch cover plate assembly has been dynamically balanced. On several occasions, I have found these items to be alarmingly out-of-balance even when using a Phoenix crank', so nowadays, I always have have my engines dynamically balanced. The following photos show how much metal can require removal to achieve a well-balanced bottom end ….

Some owners of sporty A7 engines have their flywheels lightened and whilst this might be an advantage in a racing scenario, I have never dabbled - probably due to cost if I'm honest. In my experience, a modestly tuned and well set-up A7 engine will pick-up pretty quickly and reasonably rapid gear changes are quite achievable. I have therefore convinced myself that until someone gives me a whopping great lathe – an unmolested, reassuringly heavy original flywheel will be just fine - and maybe even contribute to a smooth running engine.

The next instalment (Part 3) will discuss how I prepare the Cylinder block, pistons, head and valve gear.

……… Spanner