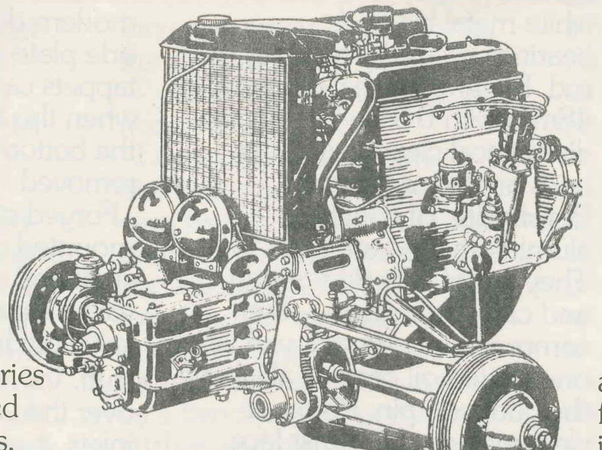
A Look at Bottom Ends and Such

Part One, by Roger Brundle



The Austin/Morris 'A' series engine which has powered innumerable Austin A30's, Morris Minors, Minis ad nauseum has long been held up as an astonishing example of engine development. In the 28 years of production this venerable lump of ironmongery which started life at 803cc producing 28bhp has been stretched to 1275cc and persuaded to finally produce 65bhp in single carburettor mass production form. Great, but what about the Traction? Born 20 years earlier than the A series engine, and developed during what was largely a limbo period of automotive development, the 4 cylinder Traction engine had an equally remarkable history. The 7A engine of 1934/5 had a bore and stroke of 72x80mm giving 1303cc and produced 32bhp at 3200rpm, on a compression ratio of 5.7:1. Changes rung on the bore and stroke theme subsequently produced 78x80mm and 72x100mm, 1628cc versions with little power increase, but more torque, before the 78x100mm, 1911cc configuration of the type 11 was settled on, a size which continued to the end. The final (11D) engine of 1955-7 produced 65bhp at 4000rpm, by which time the compression ratio had risen to the giddy heights of 6.8:1.

If we cheat a little, this comparison can be taken a little further, as the 78x100 1911 DS/ID engine produced until 1966 was basically the 11D engine with a crossflow (with hemispherical combustion chambers) aluminium head grafted on. With the help of a dual choke Weber carburettor, no less than 83bhp was wrung out. So in 32 years, the original design was stretched in size by 50% and power increased 250%.

That the engine was capable of such remarkable development was due primarily to the brilliance and advanced thinking of the original design. To quote from 'L'automobiliste' no. 37:

'Two designs were tried, Sainturat's which was considered best, being simpler, and consequently adopted, and Jouffroy's which was more traditional, and rejected. 'And yet Sainturat used some design features which had never heretofore been used on mass production cars, but had been the prerogative of higher priced vehicles such as Hotchkiss, Delage and Talbot. These were pushrod operated overhead valves, and 'wet' removable cylinder liners, which were very advanced thinking at the time, obviating tricky and expensive rebores, and used only in powerful foreign engines such as the Austro-Daimler. Conversely, very exact machining of the mating surfaces of head and block were needed to ensure perfect sealing against the combustion pressures. 'The engine in prototype form proved troublesome, the lubrication system was faulty, and then it overheated. The four bladed fan was ineffective, especially as due to its short stroke compared to its predecessors it revved far faster. By the autumn of 1933 it had developed into a brilliant design, very economical and yet particularly powerful since it developed 25bhp more than the previous side valve engine, or about 23bhp per litre.'

Taking a fifties 1911cc unit as the example, as this is the form which is now most common, and saves the trouble of tracing the perambulations of the carburettor, exhaust manifold, engine mounts etc., the first observation is that it's bloody heavy. With accessories, it must go close to 200kg. By comparison, a modern design of similar size, the 2 litre BMW engine weighs 140kg. The engine is also physically large compared with modern 2 litre designs, due to the long 100mm stroke, generous bore spacing, and necessarily long main bearings.

The cast-iron water jackets and crankcase are cast in one unit with an open deck at the cylinder head joint line — a feature made necessary by the removable wet liners. These liners are spigoted at their base into the block, and clamped at the top by the cylinder head. Machined flats on the upper periphery locate the liners in pairs. This layout has a number of advantages — the open deck design of the block makes for better control of water jacket casting and allows almost the full depth of the liner to be surrounded by coolant leading to lower thermal distortion and consequently lower bore wear. A better grade of cast iron could be used for the liners, again producing lower bore wear. When they finally wear out they can be relatively easily replaced, obviating the need to engage the services of your friendly rebore expert (?). Knowing that the designed clearances will be correct, something that is a bit of a gamble with the aforementioned reborer is a definite advantage. Pistons and liners can be removed and replaced without disturbing the bottom end of the engine, and in fact, without removing the engine.

The disadvantage of this arrangement is the precise machining necessary to ensure adequate water sealing, which increases cost and is the reason why your Holden has bores machined direct in the block. Also, casting techniques and
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materials have improved to the extent that when the bores are worn out in modern engines, it's long past time to throw the rest away. Some might say it's time to throw the rest away long before the bores are worn out. The crankshaft is carried in three main bearings and features bolt-on counter-balance weights. The main bearings are white metalled (lead plus 8—10% tin) bronze shells dowelled into the housings. Main journals are 50mm diameter and as is usual practice with white metal bearings, the diametrical clearance is on the high side at 0.041—0.081 mm. End clearance is adjustable by means of shims, and is 0.1—0.25mm. Clutch thrust is taken by the flanges of the rear main bearings. No undersize replacement shells were/are available, the accepted method of taking up wear being to file the cap faces ('Take this 'ere bloody big file, young Fred, and whip a bit off it!')

The connecting rods are forged steel of decidedly slender proportions with white metal big-end bearings poured direct into the rod. Big-end journal diameter is 48mm with 0.044—0.061mm diametrical clearance. Little ends are bronze bushed. Pistons are, of course, aluminium, and are quite long. They are of split skirt design, and carry four rings — two compression, one grooved, and one slotted oil control, all above the gudgeon pin. Piston clearance on the thrust face was originally 0.06 — 0.08mm, but this may vary with replacement piston and barrel sets.

The camshaft is driven by an endless duplex (twin row) chain with no tensioner. A duplex chain is used as the drive for the water pump fan and generator is taken from the forward end of the camshaft via a single dog coupling and short drive shaft in the bell-housing.

The three-bearing camshaft runs direct in the block and end-thrust is taken by a thrust washer bolted to the block at the rear adjacent to the drive sprocket. Designed end float is 0.12—0.25mm.

Valve timing, as befits the age of the design, is quite moderate, and contributes to the excellent low-speed torque.

At checking clearances of: 0.014" (0.34mm) inlet, and 0.016" (0.41 mm) exhaust,

Inlet valve opens 3°BTDC Inlet valve closes 45°ABDC	period 228°
Exhaust valve opens 45°BBDC Exhaust valve closes 11°ATDC	period 236°

It appears that this timing was used on all types, although Dumont mentions that the camshaft of the 11D was modified to improve performance (presumably longer period, more overlap). However, early ID/DS engines had the valve timing given above, and later units have had **more** conservative timing.

Hollow cylindrical tappets are used and the pushrods, although quite short by contemporary standards, now appear to resemble knitting needles, compared with modern designs. As ther is no side plate on the block, the tappets can only be removed when the head is off, or from the bottom with the camshaft removed.

Forged steel rockers are mounted on a hollow rocker shaft and operate inclined valves running in replaceable valve guides — all standard stuff. Valve head sizes grew over the years to 36.7mm inlets, and 33.8mm exhausts, and although the overall lengths seemed to vary considerably, the stem diameter of 8.9mm and the 30° seat angles remained unchanged. Split conical cotters secure the valve spring caps.

By modern standards, the lubrication system is nothing unusual with one exception, but it must be remembered that this engine was designed at a time when quite a number of engines were still lubricated on the 'spit and hope' principal. A skew gear on the camshaft drives the gear-type oil pump in the sump and oil is picked up from the 8 pint sump through a gauze screen and delivered to the centre main bearing and main oil gallery running along the righthand side of the crankcase. This gallery feeds the front and rear mains, and the camshaft bearings through drillings. The timing chain is also sprayed with oil under pressure. At the rear of the main gallery is an oil pressure switch and a take-off for the external oil feed to the rocker shaft. Very early (pre-war) engines were wick-fed to the rocker shaft — Good Grief! A groove in the top of each rocker feeds oil to push-rod end and top of the valve stem.

Designed oil pressure is 20—30psi at around 1800rpm (30mph top gear), and is adjustable at the oil pressure relief valve which is accessible only with the sump off.

Crankcase ventilation is provided by a road-draught tube bolted to the lefthand side of the block and cunningly arranged so that it covers the underside of the car with oil.

The exception to standard lubrication practice mentioned earlier is the total absence of an oil filter, if one discounts the gauze-type screen on the pump inlet, which is really only capable of straining out large rocks and small animals. The lack of an oil filter can only be tolerated because of the ability of the relatively thick and compliant white metal main- and big-end bearings to swallow debris which would cause havoc with thin-wall bearing shells. It is interesting to note, however, that even the late engines (11D, ID19) which had modern thin wall bearings didn't have an oil-filter either — blind faith?

A pressed steel sump prevents all the oil (well most anyway) from being deposited on the roadway and is sealed by cork gaskets.

Turning to the ancillary equipment, one finds the generator and waterpump/fan driven by a single vee-belt from a pulley mounted on the camshaft-driven bell-housing drive shaft. On Slough-built cars, the generator (sorry Carruthers, dynamo) is usually a 12 volt Lucas C39PV L-O although earlier cars may have a C45PV3 CJ26. Output of the C39 is 17amps at 1850—2100rpm, whereas the C45 can only manage 13amps at 1500—1700rpm.

The French-built cars are, of course, 6-volt and may sport a generator built by Ducellier or Citroën themselves. Maximum output is 15amps at 2500rpm whic explains why the lights on French cars resemble hung-over glow worms.

A multitude of different water-pumps were fitted at various times, varying only in detail. The type with lead-covered gland packing persisted until at least 1953 in English models and possibly later. Certainly the 11D had a proper face seal which went a long way towards eliminating the dreaded water-pump drip — cause of many slipping or frozen clutches.

Lucas also provided the distributor on Slough-built cars, usually a DKY44A CJ32 unit featuring both centrifugal and vacuum advance. Provision for manual advance/retard and the vacuum advance was made by a fiendish arrangement of bushes and plates at the base of the distributor. Rotation of the distributor is clockwise viewed from the top and contact breaker gap is 0.010"—0.012". Contact breaker spring tension is 20—24oz. measured at contacts while condensor capacity should be 0.18—0.23microfarad. Static ignition timing on early engines was 8°BTDC set by inserting a 6mm pin through a hole in the bell-housing and picking up a slot in the flywheel, later increased to 12°BTDC. Which is a hell of a lot of advance!

Fuel arrives at the carburettor courtesy of a mechanical fuel pump mounted on the lefthand side of the block and driven by an eccentric lobe on the camshaft. Pumps are AC (English), Guiot and SEV (French) and may or may not incorporate a glass filter bowl, depending on the weather, probably.

As mentioned earlier, the carburettor was one item which varied considerably over the years, always of Solex manufacture, although I've heard that some 11D's were fitted with a Zenith (post-fitment?) Early post-war cars were fitted with a Solex 35FPAI — a downdraught instrument of massive proportions, later changed to a more compact 32PBIC. These carburettors feature a diaphragm accelerator pump and a built-in separate starting jet system as opposed to the more usual choke-flap.

Well, that's what it looks like. With the advantage of considerable hindsight, what inbuilt problems did it have? Surprisingly few, in spite of its early beginnings, and the reputation for long life was well won. By now, all the components are getting on, and most breakages are due simply to old age. The real problem these days is in reconditioning worn out parts at a cost which doesn't cause immediate bankruptcy, and that isn't easy as some of the skills required are rapidly disappearing. Fortunately, there are more ways of rebuilding engines than the workshop manual would have you believe, and these will form the basis of a future article.