Technical Topics

Edited by Mike Wilkins

The Heavy-Weight Single Engine

The following notes give general details on the post war AMC Heavyweight single engines which were used in the AJS 16 and 18and Matchless G3 and G80 models. The competition engines are not covered (suffix 'C').

These engines had a reputation for being reliable and quiet, however, they were not very quick. In general, they are easy to work on. The 350 engine can be particularly sweet while the 500cc engine is not much more powerful and can vibrate. They are not readily amenable to tuning for further power, but if you wish to try, take a close look at what AMC did with the competition engines.

Historical Summary – The single engine has a direct lineage back to the 1924 350cc. Matchless engine, which had a bore of 69mm. and a stroke of 93mm. The major pre-1945 design changes were as follows:

1930 - dry sump lubrication by plunger pump in the timing side crankcase.

1931 – Individual camshafts acting directly on tappets.

1935 – Engines introduced into the AJS range; hairpin valve springs used on some Matchlesses.

1936 – Enclosed valve springs; production of G3 with coil valve springs for the army.

1938 – Single crankcase boss for oil pipes.

1941 – Lightened 350 Matchless introduced (WD41/G3L).

The main features of the 41/G3L were; Aluminium crankcase, timing chest and rocker box, iron flywheels, barrel and cylinder head.

Two, drive side ball main bearings and timing side a light roller bearing assisted by a plain bronze bush. Three row, caged roller big end with a 7 3/8" long conrod.

Single start, reciprocating plunger oil pump, with 3/16" groove, driven from a 7/8" diameter timing side axle.

A compression ratio of 5.88:1 with plate and 6.3:1 without. Coil valve springs and adjusters at the top of the pushrods. Magneto mounted behind the engine driven by chain from the inlet camshaft

Post 1945 – Major Changes

NB: The production year ran from August of the preceding year to August of the stated year.

1946 – Civilian production recommenced: 350 engine as 41/G3L except inlet increased to 1", 500 engine with larger crankcases and a bore of 82.5mm and a stroke of 93mm, inlet increased to 1 3/32". AJS range of models introduced using the same engine but with the magneto in front of the engine, driven from the exhaust cam

1947 – Conrod shortened by 0.5" and gudgeon pin move 0.5" lower in piston. Two start (double capacity) oil pump fitted, two piece guide pin used and timing side axle changed to suit pump. Timing side roller bearing deleted and bronze bush lengthened

1948 – Pump guide pin increased in diameter to 0.25" with corresponding change to plunger. 500cc crankcase and flywheels used on the 350cc engine, with the cylinder changed to suit. Wire-wound pistons introduced on the 500cc engine

1949 – Hair –pin valve springs re-introduced with longer valves and guides, valve end caps omitted, much enlarged cylinder head and rocker box. Valve lifter moved to rocker box. Wire-wound pistons introduced on the 350cc engine

1950 – Bronze crankpin washers replaced by steel

1951 – Alloy cylinder head introduced. Crankpin washer discarded and flywheels altered.

1952 – Magneto moved in front of cylinder and driven from exhaust cam, on Matchless engines. Open valve spring trays used. Compression plate omitted on 500cc engine and barrel lengthened to suit. Change in drive side main bearing fit. Increased valve lift cams (from0.3125" to 0326").

1954 – Increased oiling to cylinder head with oil grooves in rocker arms. High lift cams fitted (increased to 0.362"). Timing

side axle diameter increased to 1 1/8" with changes to flywheel, cranckcase and mains bush to suit. Thinner flywheels fitted. SR1 magneto and auto advance / retard fitted to 500cc engine with a new magneto chain cover.

1955 – Monobloc carburettor introduced, inlet bore diameters increased to 1 1/16" (350) and 1 5/32" (500). Larger, drive side inner main bearing used, with modified cranckcase, with a single washer fitted between the bearings. New keyway arrangement on drive side axle and flywheel. Circlip fitted to exhaust valve guide. SR1 magneto and automatic advance / retard also fitted to 350cc engines.

1956 – Cylinder oil feed discontinued, Compression ratios increased to 7.5:1 (350) and 7.3:1 (500). Magnetic drain plug fitted. Shorter pushrod tubes fitted with changed cylinder head.

1957 – Engine shock absorber removed, drive side axle shortened.

1958 – Drive side crankcase altered to suit aluminium chaincase. Drive side axle changed for alternator. Change to coil ignition with contact breaker driven from inlet camshaft.

1960 – Scallop for single down tube frame omitted from front of crankcases. 500cc head fitted with larger valves, piston changed to suit valves.

1962 – 350cc short stroke engine (bore 74mm. and stroke 81mm.), respective changes to crankcases and flywheels, barrel with enclosed pushrods, new cylinder head using some 500cc valve gear parts and 1 1/8" diameter inlet.

1964 – Oil system changed to Norton gear pump with changes to crankcases including timing side roller bearing, tappet guides and timing gear, contact breaker moved to end of exhaust camshaft. Bores changed to 72mm (350) and 86mm (500), strokes changed to 85.5mm (350) and 85.5mm (500), with changes to flywheels and barrels to suit. 500cc engine barrel had integral pushrod tubes. 500cc cylinder head inlet diameter reduced to 1 1/8".

Potential problems

Crankpin – The 500cc. Engine suffered from occasional crankpin breakage. The necessary use of pattern single piece crankpins exacerbated this problem.

Oil feed boss – The boss on the timing side crankcase can be broken by poor spanner work. The threads in the aluminium for the unions can easily be stripped by cross threading. The oil pipe to the top of the engine can break at the rocker box. Do not use a solid pipe connector when joining the long oil feed pipe to the short rocker box pipe, just a flexible rubber tube.

Shock absorber spring – This can break, particularly if a sidecar is fitted to the bike.

Valve gear wear – The contact between the hairpin valve spring and collar wears and to a much lesser extent, the spring tangs and spring tray.

Inlet valve sticking – Carbon from the valve stem oiling can stop the valve from closing. This sticking is often a problem if the bike has not been used for some time.

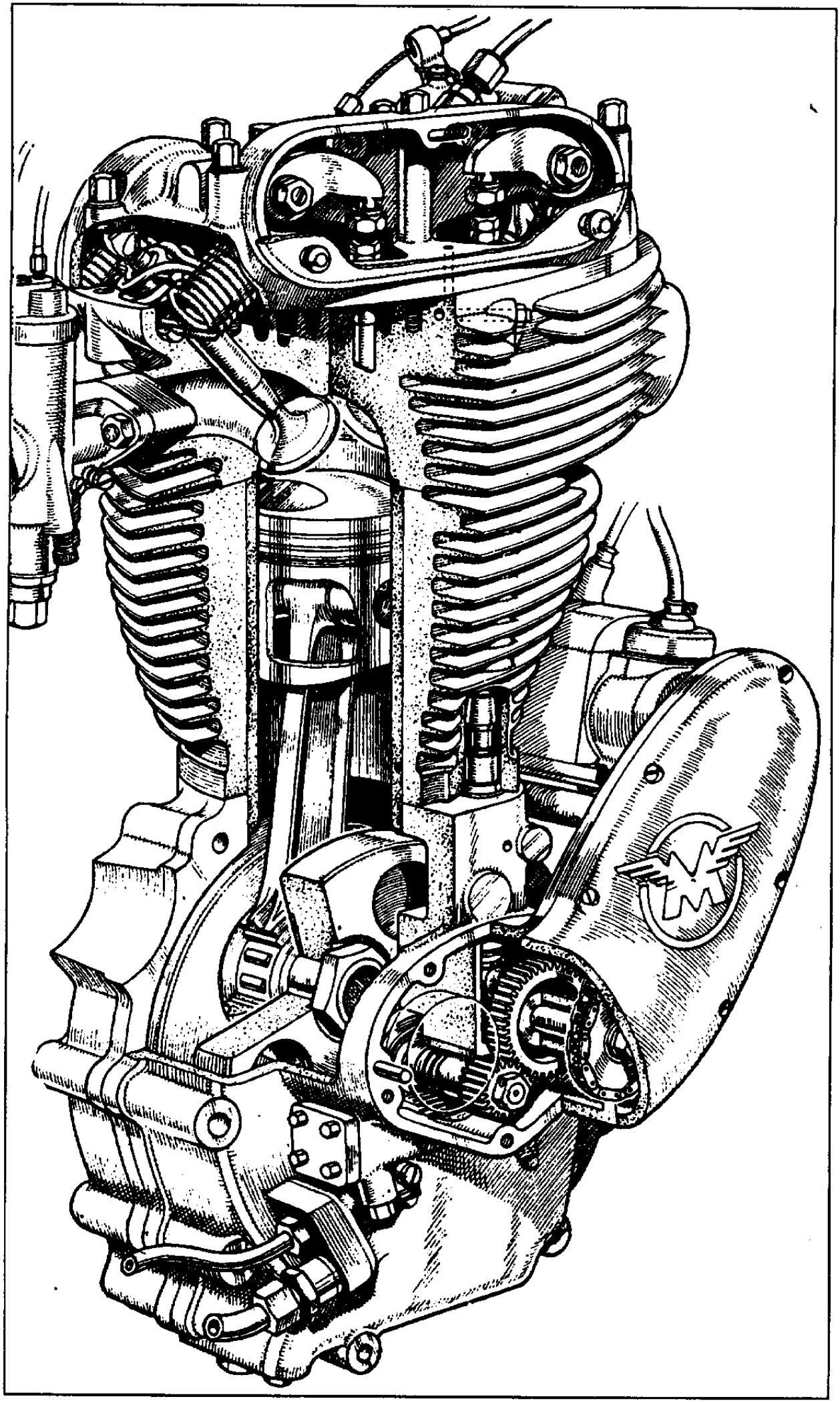
Timing pinion cracking – The pinion can crack, usually due to someone try to undo the retaining nut and not realising it has a left hand thread.

Piston cracking – Pistons can crack either across the dome or or around the top ring groove. This is usually associated with pattern pistons and a large right hand. Less serious, in the short term, is the skirt cracking from expansion slots on some pattern pistons.

Automatic advance and retard unit – The unit used on the coil ignition engines must be lubricated by the user (users not realising this has resulted in most being worn out prematurely). To lubricate the unit, remove the bolt that holds it to the camshaft and inject a couple of shots of engine oil up the centre, replace the bolt (the timing will not be affected). Do this every few thousand miles.

Rocker box gasket – Some pattern gaskets destroy themselves due to the movement between the head and rocker box.

Oil pump (not the Norton gear pump) – The oil pump is almost fool proof, but the one and two start plungers are not interchangeable, likewise the associated 7/8" timing side axles. All plungers with a 1 /4" groove and all 1 1/8" diameter timing side axles should be two start. A two start axle has two threads on the worm that drives the plunger. A 3/16" groove two start plunger is more difficult to identify, it



should have 2S stamped on it. If in doubt, place the plunger and axle together as if they were in the crankcase and they should naturally lie at right angles to one another. If not do not use them together. The correct guide pin must be used with the plunger and if there is a flat on the pin it should be replaced. On later engines wear between the plunger and timing side axle can be significant. Oil draining into the sump from the oil tank indicates a scored pump bore. This can be sleeved by a good engineering shop. If the pump does not return oil to the, the fault will either be a blocked oil passage, upstream or downstream of the pump or air leaking into the scavenge oil passage in the crankcase at one of the screw blanking plugs.

Dismantling & assembly advice

NB. Any work should be done using a workshop manual.

Care must be taken when undoing oil pipe unions.

The oil pump plunger must be removed before separating the crankcases. On engines made between 1954 and 1963 the timing pinion need not be removed from the axle.

Spacing washers must be used between the drive side main bearings, two before 1954 and one after.

The crankshaft end float, without the engine shock absorber, sprocket or alternator fitted, must be greater than 0.020". If it is not fit a tube, with a bore greater than the outside diameter of the main bush, over the protruding end of the bush and tap the crankcase. On 1954 and later engines the crankcases will have to be split and the inside face of the bush machined back. If there is end float with the shock absorber etc. fitted and tight the main bearings are loose in the drive side crankcase.

When assembling the oil pump check that the guide pin has engaged the plunger and that the front end plate gasket is not masking the oil hole in the end plate. The top right bolt for the rear end plate may need shortening as it can bottom on the guide pin holder.

When the crankcase halves are assembled there should be less than a 0.020" step at the crankcase mouth. If it is greater the halves are probably not a matching pair. Before the piston is fitted, put the cylinder on the crankcase without a gasket and with the crankcase through bolts loose. Do up the the cylinder base nuts tight followed by the through bolts. Do not disturb the two through bolts, which solely hold the crankcases together. After the barrel has been removed the flywheels should rotate freely.

If new piston rings are fitted, the glaze on the cylinder bore should be lightly removed with emery paper. A proprietary emery flap wheel is sold for this purpose. The wear step at the top should be removed or at least blended out.

Use PTFE tape to seal the return pipe union in the crankcase. Do not over-tighten.

The valves on the 500cc. engine are visibly very similar, mistake them at your peril. The exhaust should be marked EXH or something similar. If in doubt the exhaust valve will be only slightly magnetic or not at all.

Use Viton O-rings to seal the top and bottom of the push rod tubes. The top seal can be a stack of rings the same height as the cylindrical gland rubber supplied in the gasket set, or a single ring sandwiched between two lengths of the gland rubber, cut so that the over-all length is the same. The correct washers must be used at the top of the push rod tube, a plain one on top of the seal and a conical one on the shoulder of the tube. The plain washer is often trapped in the head.

Make sure that the small oil feed hole, (on top of the cylinder head, between push rods), is not masked by the rocker box gasket. The screw that controls the supply of oil to the inlet valve guide should only be open by a third of a turn.

Cut the seal rubber for the tappet inspection cover to the correct length and join the ends with super glue to make ring.

The sparking plug should be a Champion N5, Bosch W8CC or NGK B7ES. It is probably unwise to use an N9Y as an equivalent to the N5.

All rubbing parts, bearings and gears must be well lubricated during assembly, use clean engine oil or if the engine is going to stand for some time before use, a high quality anti-scuffing paste.

John Allen (1982)