The Coventry Climax Engine

As is generally known, the Coventry Climax single overhead camshaft engine originated as a unit designed for driving a lightweight fire-fighting pump. The basic requirements for this duty, such as ability to run for long periods at high speeds demanded a direct-coupled centrifugal pump and the necessity for light-alloy construction where feasible, are obviously similar to those specs called for in a competition car engine. It was soon evident to those interested in the latter application that here was an engine fully capable of being adapted with little modification to the more exacting needs of a variable speed high power unit for sports and competition cars.

The Coventry-Climax Engineering Co. of Coventry England is one of the oldest in the specialized field of manufacturing engines. In 1950, the British Government requested Climax to design and build a prototype package consisting of a 35 horsepower gasoline engine coupled to a water pump, the whole unit to be enclosed in a light tubular framework. The pump characteristics demand a speed of 3500 rpm and the engine thus began - - with a clean sheet of paper.

Climax's technical director, Walter Hasson assigned a man newly imported from B. R. M. to the project, Mr. Harry Munday. Together, these men directed the layout, construction and testing of an entirely new powerplant. The pump specifications on weight (350 pounds) required aluminum alloy wherever possible and it was quickly decided to build a four cylinder inline unit of only 61 cubic inches featuring a single overhead camshaft. Pushrods and rocker arms would have been perfectly satisfactory for 3500 rpm, but even at this early stage the designers felt that this very light engine might possibly have other uses for which speeds of 6000 or even 7000 rpm would be necessary. Furthermore a pushrod engine has definite limitations as to porting because the pushrod clearance holes must pass through the cylinder head on one side or the other. The SOHC was not much more expensive, imposed no limit on revolutions, and of course allowed ample size ports. It does entail a weight penalty of possibly 5 lbs., but in fire pump service the advantage of permanently adjusted tappets which stay put after as long as a week of continuous running was considered extremely advantageous.

Near square cylinder dimensions were desirable and the original commercial version had a bore and stroke of 2.75 x 2.625 inches. Later, when it was decided to build a sports car engine the dimensions became 2.85 x 2.625 (1097 cc) FWA. The 3.00 x 3.15 (1460 cc) designated FWB and the 3.10 x 2.625 (1216 cc) designated FWE followed the initial design. The type FWE engine was developed after the FWA and FWB. The idea behind the FWE was to get an engine nearer the top of the 1300 cc Grand Touring class. The 1216 cc engine is a cross between the 1100 and the 1500 cc. Problems with the crankshaft in the 1500 engine limited the rpm to less than 6000 rpm. The 1216 engine used the 1100 crank and the 1500 bore in a new block.

It was the FWE engine that powered the Elite during its production run. The following description pertains to that engine.

The Main Casting

The integral crankcase and cylinder block is an aluminum alloy casting, with the bottom sump flange carried well below the center line of the crankshaft. The cylinder bores are formed by dry slip-fit liners of the centrifugally-cast type with flange location. The block has generous water spaces all around the cylinders, and there are three massive webs to carry the main crankshaft bearings. The cap studs are reduced on their shanks to a diameter below that of the threads.

The forged steel crankshaft is carried on three bearings of the steel-backed thin-wall lead-bronze type, the shaft having integral counterweights. The journal diameter is 2.125 in., with a length of 1.0 in. The crankpins are 1.875 in, in diameter. The shaft is located by semi-circular thrust washers fitted on each side of the center bearing. At the rear of the back bearing the shaft diameter is increased for an oil return scroll and piston-ring-type oil seal, which runs in a register in the rear housing. The steel flywheel is spigot-mounted on the shaft and secured by six bolts locked by tab washers.

Connecting Rods and Pistons

The connecting-rods are of conventional H-section, of alloy steel with big end bearings of the thin-wall steel-backed lead-bronze type. The big ends are split diagonally to allow withdrawal up the cylinder bores, the caps being located by tongue and groove. The big-end bolts are 0.35 in. diameter, and their fit in the cap holes locates the latter with added accuracy. The small-end bushes are of Clevits type with a press-fit; the gudgeon pins are fully floating and circlip-located in the piston bosses.

The aluminum alloy pistons have two compression and one scraper ring, all located above the gudgeon pin. The compression rings are of a Dykes design, having a section which gives extra sealing by gas pressure. The top ring is chromium plated. At the front of the crankshaft are fitted the jackshaft driving sprocket and the fan pulley, mounted on suitably machined diameters; they are secured by Woodruff keys and held axially by an end-nut. An oil thrower ring is positioned between the sprocket and pulley, and an oil seal is fitted in the front cover, locating over the pulley boss.

Camshaft Drive

The drive for the oil pump and distributor is taken from a skew gear mounted on a jackshaft on the right-hand side of the engine, this shaft being gear-driven from the crankshaft. The skew gear engages the driven gear of a vertical spindle, at the top of which the distributor is located in an accessible position. The lower end of the shaft continues downwards to couple up with the oil pump bolted in the base of the sump. The jackshaft runs in two bi-metal bearing bushes, and in addition to its gearwheel at the front end, carries on the outside of this the chain sprocket for the camshaft drive. Both gear and sprocket are secured by Woodruff keys and locked by a tab-washered center bolt. The jackshaft end-float is controlled by a locating plate between the gearwheel and the end bearings.

The camshaft runs of course at half crankshaft speed, and in order to spread the wear evenly over the drive as a whole, both gear and sprocket ratios are chosen to give a "hunting-tooth" effect; the crankshaft pinion and driven gear have respectively 28 and 48 teeth, while the jackshaft and camshaft sprockets have 24 and 28 teeth.

Cylinder Head And Valve Gear

The overhead camshaft runs in three split white-metal bearings carried on pedestals at the top of a cast-iron tappet block. The driving sprocket is secured to the camshaft by a key, and located by an end bolt locked with a tab-washer. Each of its bearing caps is secured by two studs with nuts and spring washers; the driving chain is tensioned by an automatic leaf-spring adjuster of the Weller type.

The cams operate inverted bucket-type tappets of chilled cast iron which surround the valve stems and springs, clearance between tappet and valve stem being adjusted (after removal of the former) by means of shims of suitable thickness. The tappets take their bearings directly in the tappet block, which is held to the cylinder head by eight studs with nuts and spring washers. There are also two dowels for accurate positioning. One of these, at the rear, is hollow and conducts lubricant from an external feed union at the side of the cylinder head, to the camshaft bearings. The tappets are lubricated from a trough formed in the tappet block, and supplied by flow from the camshaft bearings.

It will be noted that the system of valve operation eliminates all side-thrust on the valve stems, while correct adjustment is maintained for very long periods.

The cylinder head is cast in DTD 424 aluminium alloy, and is secured by eighteen studs and nuts. The combustion chambers are of wedge-shaped squish formation, the valves being inclined at a small angle to match this shape and promote good flow. There are separate inlet and exhaust ports for each cylinder, and the valve seats are of austenitic steel, shrunk-in to the head.

The valves are of XB high-duty steel, each having duplex springs; the valve head diameters are respectively 1.28 in. and 1.15 in. for inlet and exhaust. The valve timing is as follows:

Inlet opens 12 deg. before tdc; closes 56 deg. after bdc.
Exhaust opens 56 deg. before bdc; closes 12 deg. after tdc.
Overlap 24 deg.

Lubrication And Cooling Systems

The gear-type oil pump draws through a floating intake strainer from the 1-gallon sump, the delivery then going to an external full-flow filter. From the filter a pipe leads to the main crankcase oil gallery, whence drillings feed the main and jackshaft bearings and timing gears. An external pipe conveys oil to the cylinder head union already mentiomed, for the feed to the overhead camshaft, valve gear, and camshaft chain. A relief valve is built into the oil-pump body, the normal pressure being 55lb per sq. in. with the engine at normal temperature and at high speed.

The water pump is bolted to the engine block on the left-hand side, and is belt-driven. It is self-contained, i.e. not built-in to the water jacket, and delivers via a hose to the cylinder block at the top left-hand side. The outlet is from the cylinder head, rear right-hand side, the flow in the head being directed on to the exhaust-valve seats.

The induction manifold is of a design promoting a degree of ram-charging, and may be equipped with various methods of carburation. The manifold is of cast aluminium and is not normally fitted with any extraneous means of heating.

The ignition distributor has vacuum and centrifugal control. Spark plugs are Champion 14-mm type N3 as standard.