

The Coventry Climax IOE Engine

(WHATMOUGH PATENTS AND OTHER MATTERS)

Submitted by John Merton

The Coventry Climax I.o.E., or rather O.I.S.E. (overhead inlet, side exhaust valve) engine used in early production Morgan four-wheelers has a number of Great Britain patents listed on a plate on one rocker cover. These, ascribed to Whatmough (Wilfred Ambrose Whatmough) are numbers 303592, 319810, 326454, 329340, 332523, 349460, and 373991. They date from around January 1929 to May 1930.

My interest in the above patents grew out of a statement in a book that the cylinder head was manufactured to a patented design by Whatmough. With little previous interest in or knowledge of the origins of the I.o.E design, I (and friends I spoke to on the matter) assumed that Whatmough had invented the I.o.E configuration, as it was the essential feature of the cylinder head design. Subsequently, an Australian historical automotive journal of good standing carried an article on Hudsons intimating that Hudson had invented the "F"-head design. This claim had been included in a 1928 advertisement for Hudson cars.

The matter triggered an examination solely to see, initially, which of the two had the stronger claims to having invented the I.o.E design.

The outcome follows. It has led into fields much wider than just patents, and challenges and refutes entrenched Morgan lore in a number of areas.

For much of the information on the Triumph connection (or more properly lack thereof as regards the particular engine used in Morgans) my thanks to Antony (Tony) Cook, founder and past secretary of the Pre-1940 Triumph owners' Club of the UK, and currently secretary of the Skoda and Tatra register in Australia.

[BACKGROUND - the Hudson and Whatmough patents.](#)

First, neither Whatmough nor Hudson invented or patented the I.o.E. design.

I.o.E. engines date almost to the dawn of motoring. The earliest tended to have "atmospheric" or "automatic" inlet valve operation, based on the principle that gravity would assist the valve opening process. Royce and Rolls-Royce cars before the "Silver Ghost" (except the V8 "Legalimit") had I.o.E. engines, and they were well-established motor cycle practice by around 1910.

Significant is their appearance in Hudson's light car, the "Essex", named after an English county, which had a four cylinder I.o.E. engine from around 1919 on, and was apparently quite a well-known sight on English roads in the 1920's. These cars were assembled for a time at a plant on the Great West Road, Chiswick. Another make to use I.o.E engines in the 1920's was Humber.

In January 1928, Hudson was granted a patent (US1656051, inventor Stephen I Fekete) for refinements to the I.o.E design. The essence of this patent, which covered the arrangement of valves, head, cylinder and spark plug, was an inlet valve overlapping both piston and exhaust valve, so that cooler inlet gases could help cool the heads of the exhaust valves while still efficiently entering the combustion chamber. The arrangement aimed at greater volumetric efficiency, higher compression without pre-ignition, higher rpm and more power, while still providing effective exhaust valve cooling. **The Patent also provided for spark plug location adjacent to the exhaust valve on the side furthest away from the piston, to spread the flame progressively from the hottest to the coolest part of the chamber, helping prevent pre-ignition.**

Hudson itself used a six-cylinder I.o.E. engine to this design for about three years in the late 1920's, but later abandoned this in favour of side valve designs. It was the

smooth running of these later engines which made such a big impression on Rolls-Royce engineers in the 1930's.

The listed Whatmough patents cover, with a single exception, combustion chamber design, aimed at gas-flow, turbulence, and volumetric efficiency considerations. While their listing on the valve cover might imply they are only cylinder head related, they also embrace gas-flow considerations affecting the cylinder block on engines with side exhaust valves. Whatmough played around with curvilinear shapes (including relieving the bore) moving later to squaring off some faces in the interests of manufacturing convenience, the clear implication being that some of his theories didn't amount to much if anything in actual practice!

Some Climax engine valve covers also carry a plate stating "Whatmough Cylinder Head", leading to speculation that he may himself have manufactured these heads and supplied them to Coventry Climax. The patent changes taken in the light of manufacturing experience tend to give some credibility to this speculation.

Basically these patents (except for the one) mostly relate to the first, involving modifications or improvements to it. A common thread is location of the spark plug over or adjacent to the exhaust valve on the side away from the piston, for the reasons stated in Hudson's earlier patent! It is almost certain that Whatmough knew of the Hudson and other work in this field at the time. "Motor Sport's" William Boddy, and others have indicated quite a lively correspondence at the time in automotive engineering journals between Whatmough and Weslake (perhaps also Ricardo - these touted as the "big three" of cylinder head design, at least in the UK), concerning their particular theories.

Whatmough's patents are catholic in relation to valve configuration, the principles seen as applicable to side, T-head, and I.o.E., with one patent also specifying O.H.V. **In other words, the patents listed on the valve cover of the Coventry Climax I.o.E. engine are not specifically directed at an I.o.E. cylinder head configuration.**

The "exception" patent, number 332523, was for cooling passages, the idea being that if adequate cooling was provided for the "hot" part of the engine, i.e. the exhaust side, the inlet side would be overcooled, and vice-versa. Whatmough's approach, basically, was to provide for larger water passages on the exhaust side and smaller ones on the inlet side. **Once again, this patent covers both cylinder head and block.**

[The Coventry Climax Connection](#)

According to a short published company history by Coventry Climax, and a separate published chronology of British Leyland, H. Pelham Lee, Coventry Climax's founder, established a car engine manufacturing facility in 1904 called Lee Stroyer. This evolved into Coventry Simplex Engines Ltd. in around 1907, leading in turn to the foundation of Coventry Climax Engines Ltd. in 1917.

The subject of our interest, the Coventry Climax I.o.E. engine, appears to have been first used in the AJS light car, from around August 1930. This, and the dates of the patents (up to May 1930), as well as Whatmough's possible "crib" of that aspect of the Hudson patent relating to sparking plug placement, do make it tempting to speculate that the adoption of this engine configuration owed something to the Essex example.

The company's Morgan connection in the 1930's came about through the supply of an 1122cc four cylinder version of the I.o.E. engine for the production Morgan 4-4, which hit the market from 1936. Early engines were claimed to produce 34 BHP at 4,500 rpm. Some time in 1936, modifications were made to the design. Reportedly, the earlier arrangement of distributor combined with a chain-driven dynamo was changed to a separate distributor driven by skew gears, the dynamo was given belt drive, the cup and ball joint on the inlet pushrod and rocker was inverted, with the cup going to the top of the pushrod, the positioning of the oil filler was changed and the lower radiator connection was moved and enlarged. Larger inlet valves and a slight modification to combustion chamber shape boosted claimed horsepower to 36.

The sideplate on the engines supplied to Morgan clearly indicates their origin. It states "Specially made for Morgan Motor Co. Ltd. by Coventry Climax Engines Ltd."

[The Triumph Connection](#)

Triumph first used the 4-cylinder Climax I.o.E. engine, in 1018cc configuration, from 1931 in its 9hp car. Subsequently Triumph adopted the design in both 4 and 6 cylinder guises for a range of its cars.

There are two theories on the actual manufacture of these. The first is that that Triumph machined and assembled them from rough castings supplied by Coventry Climax, the second that they manufactured them completely themselves given that they had suitable foundry and machine shop facilities spread over three factories, one in Priory Street, Coventry, another in Stoke Street, and the third the original "Gloria" works in Clay Lane, Coventry. Almost certainly the second was the case and this appears to be the consensus view. **The sideplate on the Triumph engines indicates they were made under a special arrangement with Coventry Climax, thus is quite different to the plate on the Morgan engines.**

Triumph used three small 4-cylinder versions of the Climax I.o.E. engine. The smallest, of 1018cc, was used in the "9" and also, in slightly tuned form, in the early Triumph "Southern Cross" sports cars. The other two small Triumph engines, specified G10 and G12, were of 1087 and 1221cc capacity respectively. The G10 engine developed a claimed 40BHP at 4,000 rpm, while the G12's claimed figures were 42BHP at 4,500 rpm. **From 1934 on, both the G10 and G12 engines were fitted with water pumps.**

Research by Tony Cook revealed no evidence that Triumph ever used the 1122cc version of this engine, even though several written works on Triumph make this claim. For example, the late Michael Sedgewick, writing in "Vintage and Veteran" magazine, opined that this was the one motor probably not made by Triumph themselves but supplied direct by Climax. Tony Cook believes however, that in this and other references the motor has been confused with the 1018cc unit actually used by Triumph. (A parallel in the Morgan world is that at least three Morgan books, and several articles possibly using the books as reference sources, claim wrongly that the post-war Standard Special engine was fitted with a water pump).

One Triumph model, the "Gloria Vitesse", used tuned versions of the G10 and G12 engines. The smaller-engined 4-cylinder models had twin SU carburettors, consisting of one small bore side draft and one larger bore downdraft on a delayed linkage. It is believed some early Morgan owners may have privately fitted this, or a similar set-up, to their vehicles.

The Triumph company ceased its involvement with Coventry Climax engines in 1937 when it completed the move to its own new in-house overhead valve designs.

[Crossley and Other Connections](#)

Crossley used the Climax 1122cc engine in its 10hp cars from 1932 on. The engine supplied to Morgan seems to have had the same basic internals as this engine but with slight differences in the block casting and flywheel/clutch, and with induction and sump arrangements more like those on the Triumphs.

It appears that Crossley ceased car manufacture in 1937, concentrating thereafter on commercial vehicles. It was another company which, through a series of takeovers, finally disappeared down the British Leyland "black hole".

Climax engines were also used in a small number of Vale Specials in the 1930's.

[Advantages /Disadvantages of the I.o.E. Design](#)

The claimed advantages of the I.o.E. design were that it allowed larger valves than either side or OHV designs (the latter constricted by the narrow bore long stroke

situation brought about by the RAC rating system), also better cooling around the exhaust valve because of more room for water jacketing. Location of the spark plug near the exhaust valve enabled the flame to move from the hottest to the coolest part of the combustion chamber, helping avoid detonation, and the system was claimed to permit higher compression ratios, hence more power, than the norm for the period. Hudson's 6-cylinder engines, for example, ran at 6-1, about 20% higher than the norm for the mid-1920's. The engine supplied to Morgan in the late 1930's had a claimed compression ratio of 6.85 to 1, also high for the period.

The big disadvantage was the heat range with which the spark plug had to cope - it had to contend with cool conditions under light load but also with very high temperatures under heavy load. Spark plug selection was a bugbear for motorists in the early 1930's using the smaller Climax I.o.E. engines. Hudson overcame this to some degree in its six cylinder engines by using the overlapping inlet valve, and also by fitting a water pump. The Triumph G10 and G12 engines were also water pump-equipped from 1934 on, a feature lacking in the Morgan engines.

[Implications for Morgan Folklore](#)

There are several claims enshrined in Morgan writ which are either incorrect or misleading. What follows addresses some of these.

Issue 1. That Morgan used the same engine as in Triumph's "Southern Cross"

Incorrect. Triumph did not use the 1122cc version of this engine. Both its G10 and G12 engines were fitted with water pumps (from 1934) and there were some other differences in specification as well.

Issue 2. That Triumph supplied engines to Morgan under a licensing arrangement with Coventry Climax.

Incorrect.

When I raised this issue with Tony Cook he was most adamant and insistent that Triumph had never supplied Morgan with any engines, they would have all come from Climax .

In support:

-the Morgan sideplates clearly state the engines are made by Coventry Climax - the Triumph engines have a quite different statement

-Morgan used the engines from 1936 to the outbreak of the War, while Triumph stopped using Climax engines from 1937

-the Morgan engines are to a different size and specification (no water pumps)

-it is highly unlikely that Triumph would disrupt its own production lines (particularly after 1937 when they were geared to OHV engines) to produce an engine to a different specification to any it had used, for a separate company, to supply to a rival car maker. Remember also that Triumph were operating at a loss for much of the 1930's

Issue 3. That Triumph owned Coventry Climax before World War 11

Incorrect. I have been unable to find one tittle of evidence to support this claim. Both the Climax-issued history booklet and the British Leyland chronology make no mention of it. In fact, the latter indicates clearly that Coventry Climax remained a separate entity until taken over by Jaguar Cars Ltd. many years later.

One might ask how Triumph, with its history of loss-making through the 1930's could have afforded to buy Climax. Or who, when Triumph went into bankruptcy in 1939 it sold Climax, by then a highly profitable operation, to? Another question also is why Triumph would walk away from an engine arrangement with Climax in 1937 contributing to a situation of some stress for Climax (see later) if Climax was in fact a subsidiary?

Issue 4. That Triumph (or somebody) must have made the engines for Morgan as Coventry Climax was too small.

Incorrect. Coventry Climax had been manufacturing and supplying the passenger car and commercial vehicle industry with engines for many years. In fact in 1937 it found the vagaries of car engine production left it with underutilised production capacity and moved to large-scale production of water pump trailers (complete with Climax engines). We are considering an operation which had the capacity to produce some 40,000 water pump trailers up to the end of World War 11. The engine sideplate also gives the lie to this claim.

Issue 5. That the I.o.E. cylinder head used on these engines is the result of research by Whatmough and Weslake.

Incorrect. Weslake is not mentioned in any of the listed Patents. Some did have co-authors, however. These were, variously, Findlater, Hewitt and White.

Issue 6. That the cylinder head was manufactured to a patented design by Whatmough.

Misleading. The distinguishing characteristic of this engine is its I.o.E. configuration. The claim is misleading if taken at face value, ie Whatmough patented and invented this design. Whatmough's listed patents, some in collaboration with others, cover gas-flow/combustion chamber shape, except for one which covers cooling,. They are not exclusive to the cylinder head, nor are they exclusive to the I.o.E. engine design.

In shorthand, the engine embodies aspects of several of the listed patents, covering gas-flow/combustion chamber design and cooling.

[When did Climax Stop Car Engine Production?](#)

By 1937, Climax's car engine operation was under stress. Triumph had been a major client throughout the 1930's, and the ending of this arrangement would have caused financial concerns for Climax. The direction of Crossley's car making efforts was increasingly wobbly, and Morgan and other clients were small fry.

The published Climax version is that by the late 1930's Leonard P Lee, then running the company, found that the natural evolution of the motor industry faced him with the need to look elsewhere for an outlet for the special types of engines which his father had produced for so many years. In 1937 an opportunity occurred to consider a Government requirement for trailer fire pumps which would utilize two engines already available. Two types of fire pumps were developed and large Government orders obtained. (The two engines involved were both side valve designs - the smaller of the two is claimed to have been that developed for the Swift, a make which disappeared in 1930).

The publication claims that Climax stopped making car engines in 1937 (it doesn't indicate precisely when that year) to concentrate on the fire pump contract.

But how does this accord with the continued supply of engines to Morgan into the first half of 1938?

Laban, in "Morgan: First and Last of the Real Sports Cars", touches on the contract situation. He quotes from November 1937 factory minutes to the effect that given a delivery of a further 250 engines was in train, at a price rise from 29 pounds to 36 pounds, the company should look to seek an amendment as soon as the suitability of the Standard (Special OHV) engine had been determined. However, according to Laban this engine had first been offered in 1937. As, by design, it draws on parts from several of its contemporary Standard side-valve engines, it would appear to have been a relatively simply matter to ring it to production quickly, assuming Morgan had been able to take this route.

However, given that they had to see out the contract and were unable, apparently, to renegotiate the price suggests that Coventry Climax may have had them over a barrel. The contract appears to have been lock-tight and the price escalation may well have been inserted by Climax at a time it was facing some uncertainties (perhaps before the fire pump contract?) and needed the cash flow .

But if they stopped making car engines in 1937, how did Morgan still get them? As we have seen, certainly not from Triumph.

I would suggest a simple answer. Common industry practice at the time was for the industry to “weather” engine blocks for anything up to eighteen months in the belief that this helped engines to “stabilize” by relieving stresses and thus made them more durable.. It is almost certain that Climax followed this practice. The Morgan engines would have been assembled from castings already made. The Climax claim therefore, is not strictly speaking incorrect but it is misleading.

[Why did Morgan Move to the Standard Special Engine?](#)

Although cost has been suggested as a factor (and the Standard engine was much cheaper), the real reason was that Morgan had no option but to look for an alternative engine. At that time also Morgan’s main competitors - MG, Singer and Triumph - were all using full OHV designs, with Singer wedded to overhead camshaft operation.

Coventry Climax had opted out of the uncertainties of car engine production to concentrate on their fire pump trailers, and the option of a further contract no longer existed for Morgan. Had such an option existed, Morgan may well still have switched engines, but the Climax engine had simply departed from the equation.

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“The Autocar”, 2 October 1936

“Morgan Four Wheeler Workshop Manual” John Dowdeswell, circa late 1950’s.

“Servicing the Morgan 4/4” Bulletin based on Motor Trade data (addendum to Dowdeswell manual)

“Morgan: First and Last of the Real Sports Cars” Brian Laban, Virgin Publishing Ltd., 2000.

“A Short History of the Fire Pump Engine that Won Motor Races” released by Coventry Climax, circa late 1960’s. Produced by Cogent Elliott Ltd., printed by WW Curtis Ltd.

“Melting Pot of Britain’s Motor Industry” Tom Northey, in “On Four Wheels”, volume 1 part 13, Orbis Publishing 1973.

“Thrilling New Limits of Performance”, advertisement for Hudson cars, page 35 “The Literary Digest” for September 1, 1928.