

# The development of Wolseley car engines: the first decade

Andy Plummer

02/02/2022

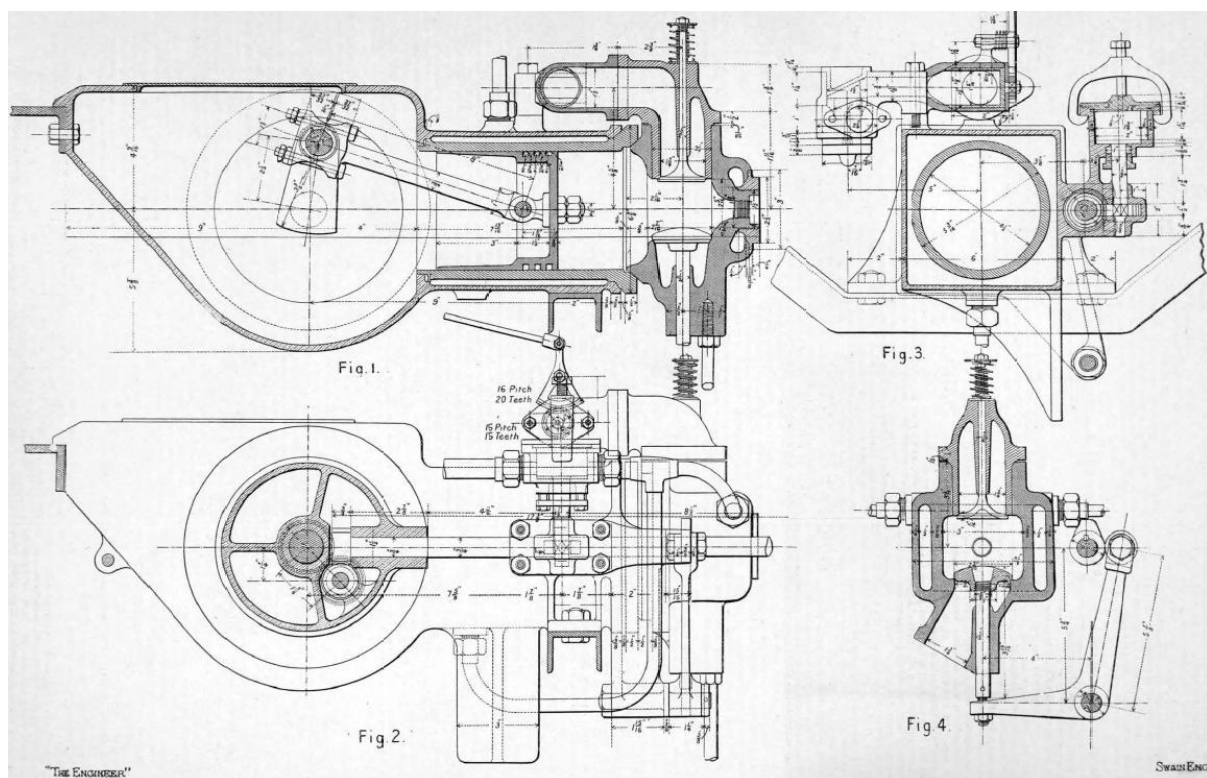
Firstly, this is an appreciation of the horizontal Wolseley engines. I make the case for the engines themselves being an effective original design, that only became redundant when the ‘fashion’ for longitudinal shaft-driven transmissions began to prevail. Secondly, I point out the many similarities between the first Wolseley-designed vertical engines (badged as Siddeleys) and their horizontal forebears. Also, comparing with other manufacturers, these vertical engines had much in common with the Napier engines of the day.

1. Wolseley horizontal engines	2
2. Wolseley (Siddeley) vertical engines	7
3. Napier engines	11
References	15
Appendix 1: Detailed description of Wolseley horizontal engines	16
Appendix 2: A contemporary design - the Benz Horizontal Engine	17
Appendix 3: Contemporary Peugeot engines	18
Appendix 4: Another aluminium horizontal engine – the Wright Flyer	19
Appendix 5: 1906 Wolseley 32hp	20

## 1. Wolseley horizontal engines

Despite the initial popularity of the horizontal-engined Wolseleys, they are remembered as a design concept onto which Herbert Austin clung for too long, and which ultimately lost him his job in mid-1905. One might get the impression that the engine design had become antiquated – but is this really true? Let's compare with Napier engines for example. The 4-cylinder engine in the victorious 1902 D50 Gordon-Bennett Napier had a number of features considered as advanced for the time: lightweight aluminium cylinder block (with cast-iron liners) integral with the crank case, detachable cylinder heads, and inlet-over-exhaust (IOE) valves. However, the truth is all these had been features of Wolseley horizontal engines since 1900 or before.

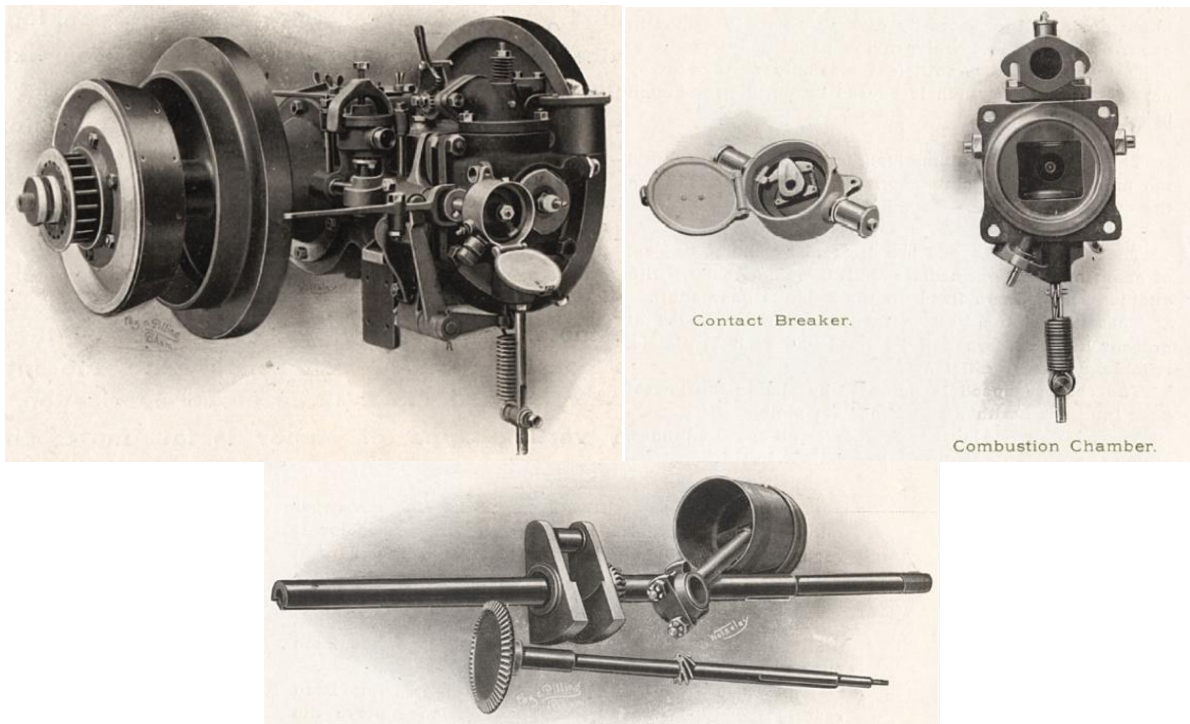
The highly capable 1899 Wolseley 'Voiturette' engine had a single horizontal water-cooled cylinder, 4.5" bore by 5" stroke (1303cc), running at a normal speed of 750rpm and developing 3.5 to 4bhp [TE 9/10/00]. Although surface carburettors and hot tube ignition were still favoured by some, the Wolseley utilised state-of-the-art spray (jet) carburation and coil ignition. The camshaft was parallel to the cylinder axis and driven by a skew (or later bevel) gear, with a 90° bell crank actuating the exhaust valve sited below the combustion chamber. In later singles and larger engines the camshaft was parallel to the crankshaft and a long rocker was used. An opposing atmospheric inlet valve sat above the exhaust. This (arguably) overhead valve arrangement gave a compact combustion chamber and a compression ratio of 3.75:1, very respectable for the time. The detachable head was also water cooled, and mated to the cylinder using a ground joint so no gasket was required. An embryonic form of this engine has been successfully demonstrated in the Wolseley 'Autocar No. 1' tricar the year before, albeit with a bronze cylinder block, and air-cooled head [Clausager, p26]. This design was arrived at after experimentation and development by Herbert Austin since 1896.



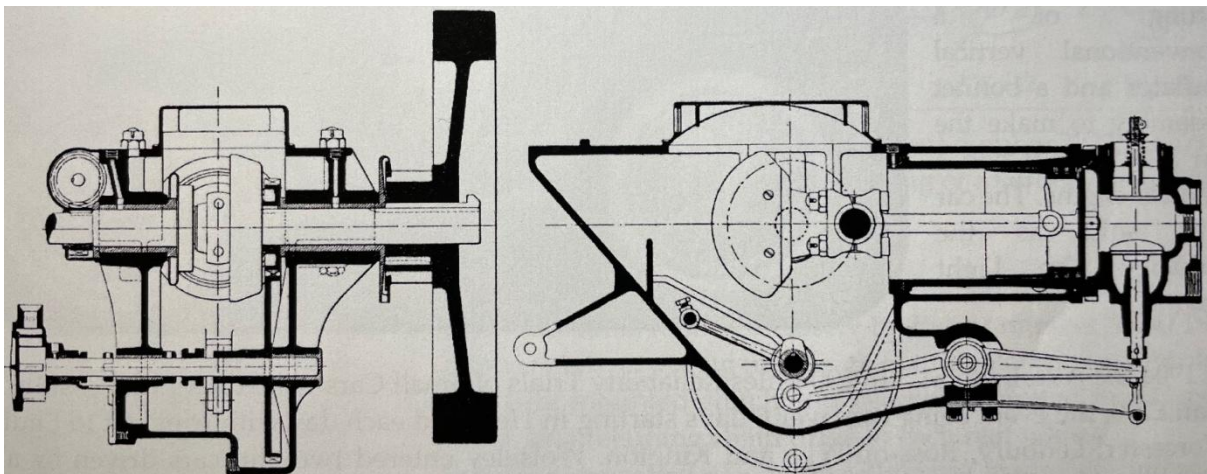
1899 Voiturette engine - from the car later registered as OWL 707. Rather than aluminium as used in production cars, the casing was gunmetal – a bronze-like alloy of copper, tin and zinc [TE 9/10/00].

The single cylinder engine was produced in largely similar form until 1906, as the 5hp or 6hp, with a total production run of about 730 [Clausager p57,88]. The very successful in-line horizontal twin version was produced 1900-1906. This had 3 main bearings, and aligned crank throws rather than spaced by 180°; this allowed evenly-timed power strokes at the expense of unbalanced reciprocating piston mass. The 4.5" x 5" bore and stroke (2606cc) 10hp became the 12hp and finally the 14hp. A smaller 4" square (1647cc) 8hp version was introduced in 1902, without a centre main bearing – the larger model eventually lost this too [TM 14/11/05]. From the end of 1905 the inlet valve was mechanically operated (the 'MOV' model) – I don't know how this was arranged. A total of 1051 of these horizontal twins were made [Clausager p57].

### Single cylinder Wolseley horizontal engine



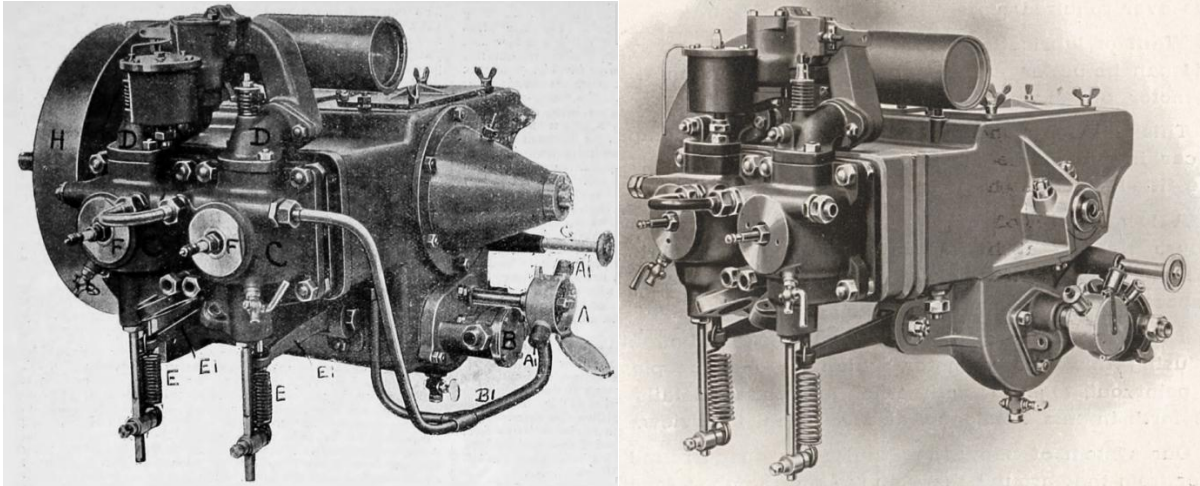
*5hp engine, 1901-1903: images from 1903 catalogue  
– the same engine image was first used in 1901 [AMJ 16/05/01]*



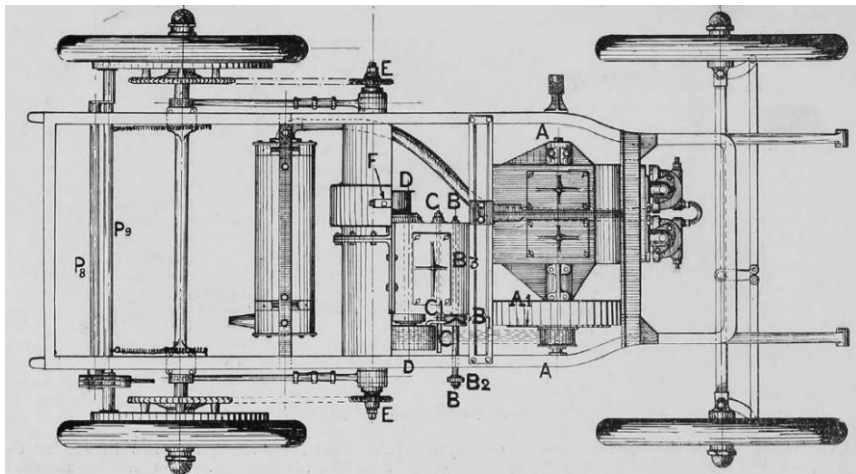
*6hp engine, 1904-1906 [Painting p29]*



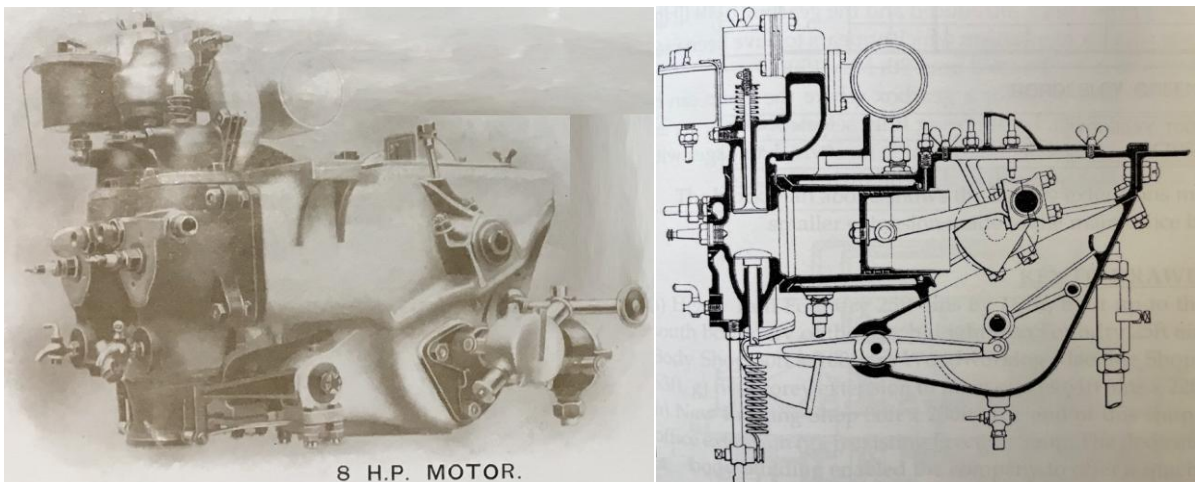
## Wolseley inline twin horizontal engine



Left, image from 1901 [AMJ 16/05/01]. Right, image from 1903 Catalogue, a version of which appeared in the press in 1902 [AMJ 31/05/02]



Plan view showing installation of the engine [AMJ 31/05/02]

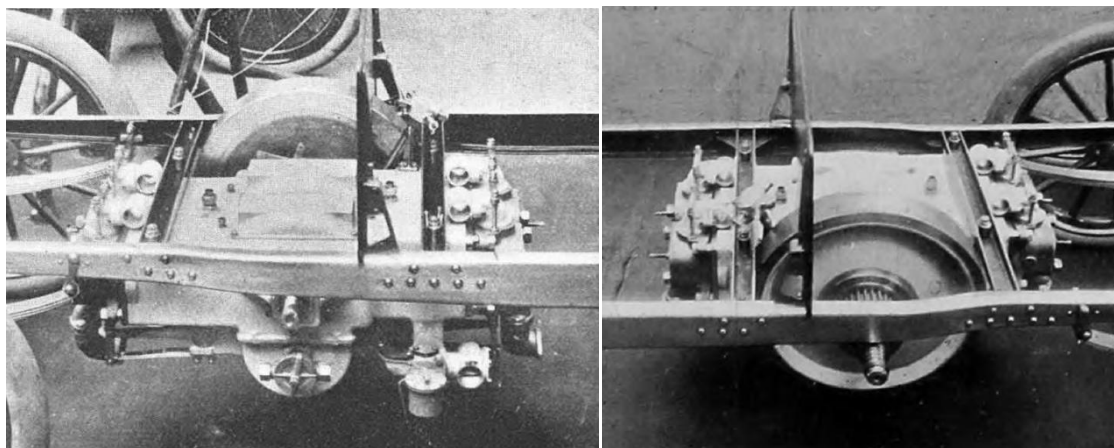


The smaller 4"x4" 8hp twin, left [1904 catalogue], was initially launched as the 7.5hp, right [Painting p22]. The exhaust valve coil extension springs in the latter are replaced by leaf springs in the 8hp.

A four cylinder horizontally-opposed version was manufactured from 1901 to 1905. Each opposed cylinder pair shared a crank pin, and the big ends being adjacent required the cylinder axes to be offset. Three main bearings were retained. The integral aluminium cylinder block and crankcase was made in two symmetrical halves, with the vertical split line on the crankshaft axis. The 4.5" x 5" bore and stroke (5212cc) 20hp became the 24hp in 1904, and was joined by the smaller 4" square (3295cc) 16hp version in the same year. The Wolseley racers of the time mostly had this type of horizontally opposed 4 cylinder engine, in enlarged form, although some were in-line fours.

So these engines were actually quite advanced, and certainly the product of original thought rather than 'following the crowd'. The horizontal arrangement allowed each bearing surface to be individually lubricated by gravity drip-feed in a very controlled manner – drip rates were specified for individual oil pipes leading to main bearings, big-ends (via drilled crank pins), pistons and little-ends. However, there were reports of lubrication problems with the 4-cylinder cars, especially the racers. I wonder whether maintaining around a dozen oil paths clear – and checking they were so via each sight-glass – was impractical. Perhaps the less controlled 'splash it around liberally' approach was actually less risky. Interestingly, whereas the 1904 Motor Vehicle Handbook (i.e. manual) claims gravity feed is totally reliable, Austin stated that the need for forced lubrication was a lesson he learnt following crankshaft failure in the 1902 Gordon Bennett race [Lambert & Wyatt, p80].

An attraction of the horizontal engine is that it is fitted neatly between the chassis rails, giving a low centre of gravity. The crankshaft axis was transverse, and was more or less below the line of the dashboard, so it could be thought of as a mid-engined car. This must have given a big advantage in terms of handling for the racing cars – the Wolseley racers were indeed described as 'steering' better than the Napiers [Montagu, p116]. The transverse engine allowed a straightforward chain drive back to the transverse gearbox-differential, from whence the rear wheels were driven by another pair of chains in the standard manner. Fashion may have been a big factor in the death of the Wolseley horizontal engines – but there was a significant practical factor too: the eradication of chains and adoption of shaft drive to the gearbox (and ultimately to the back axle) essentially necessitated a longitudinal engine, which could only be made to fit if it were vertical<sup>1</sup>. The role of fashion – "the handmaiden of the advertiser" – is bemoaned at length in a 1904 paper read to The Society of Arts, which describes 11 advantages of the horizontal engine and suggests its disappearance to be temporary, with "the Wolseley, Siddeley, Duryea, Winton, Oldsmobile, Cadillac, James and Browne, Roots, Alldays, and others amongst the persevering minority" [JSA]. Its disappearance may have been for several decades, but nowadays enthusiasts for Porsches, Beetles (of the VW variety), Alfasuds and Subarus would be eager to agree that there is nothing fundamentally inferior about a horizontal engine.

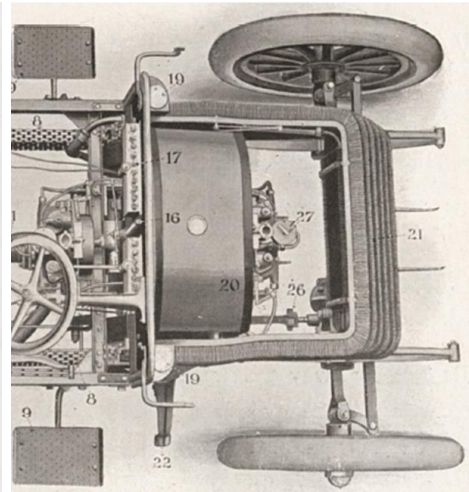
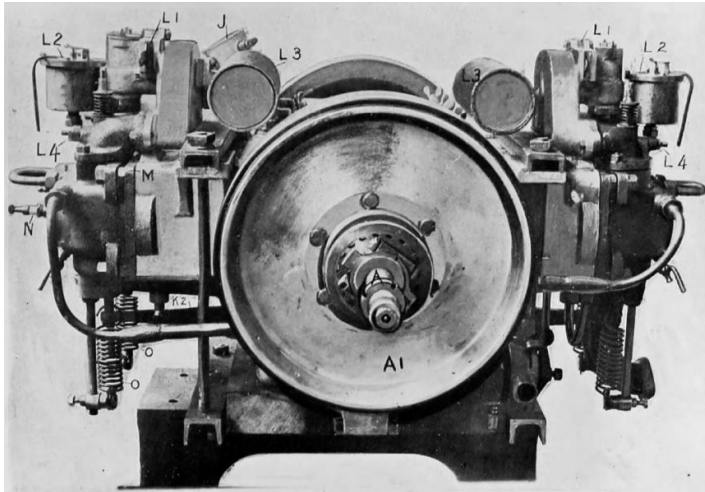


*The 1903 4 cylinder 50hp Wolseley racer engine, possibly 5.5" square (8565cc) [TA & AMJ 07/02/03]*

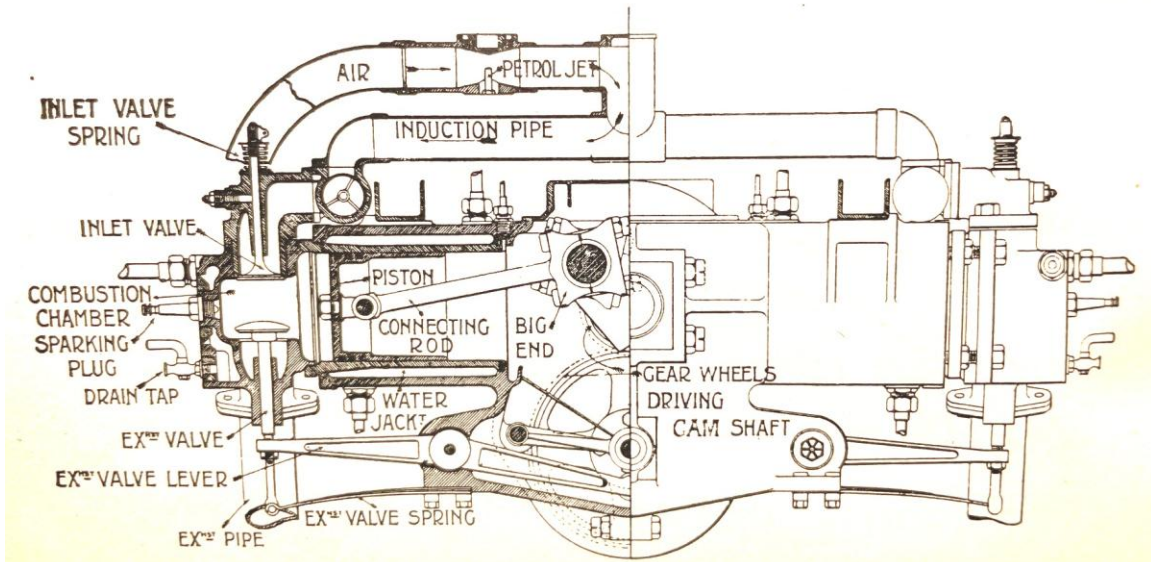
<sup>1</sup>The pivotal role of the powertrain architecture motivated Austin to write a comparison of designs, allowing him to emphasize drawbacks of the longitudinal 'Panhard System' [AMJ 16/5/01]



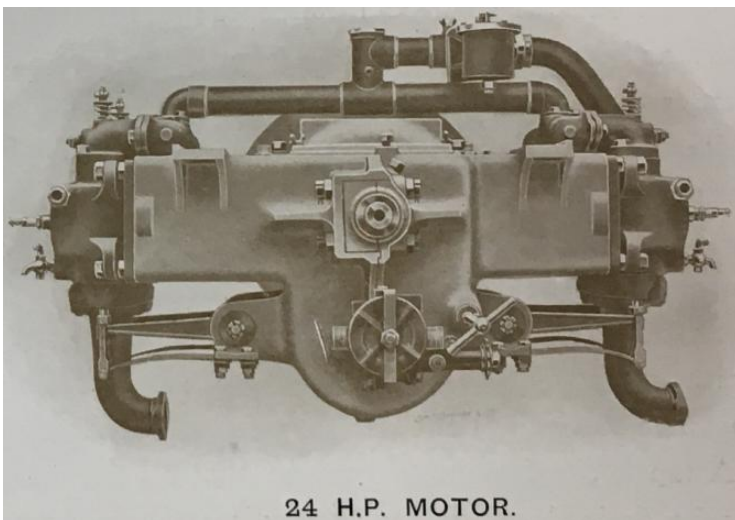
## Wolseley horizontally-opposed flat four



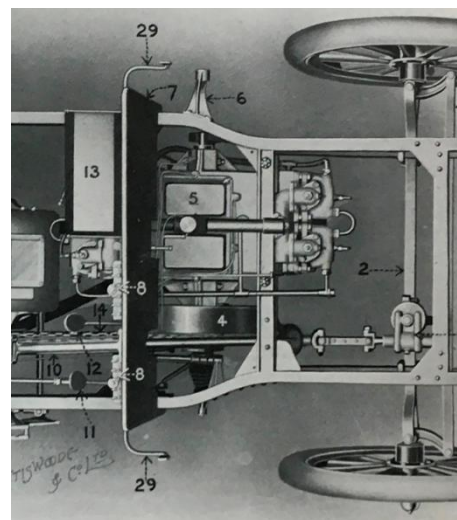
20hp four showing twin carburetors [AMJ 31/05/02], and installation position [1903 Catalogue]



1904: single carburettor and leaf sprung exhaust valves [1904 Instruction Manual]



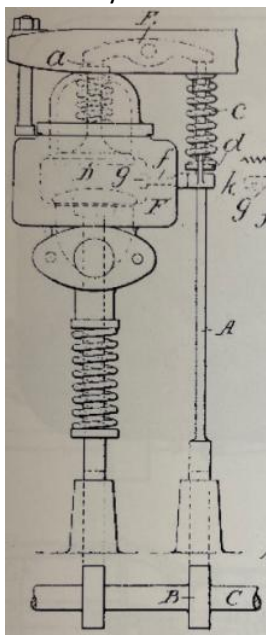
Same 4.5" x 5" (5212cc) engine rebadged as 24hp [1904 Catalogue]



## 2. Wolseley (Siddeley) vertical engines

So Herbert Austin is thrown out in 1905, John Siddeley is in charge, the horizontal-engined cars are abandoned, and Wolseley starts again manufacturing completely different engine designs ... is that what happened? Well of course it's not that simple. In fact the first new design, with vertical engine, was the 4 cylinder 18hp Siddeley in January 1904, quickly followed by the 2-cylinder 12hp version, and a single cylinder (6hp) vertical-engined car a few months later. The 18hp in various guises was particularly successful over the next few years. If not designed by Austin himself, it was certainly the work of his design team under Chief Draughtsman Alfred Remington. It had a lightweight aluminium monobloc cylinder casting integral with the crank case, cast-iron liners, detachable cylinder heads with ground joints, and IOE valves ... so in fact many of the key design features of the horizontal engines. The Automotor Journal noted the similarity when describing the new Siddeleys: *"The cylinder itself is, in accordance with the invariable practice of the Wolseley Company, formed by a cast-iron liner that fits down inside the jacket, and the cylinder-head – which is independently jacketed – is held down in place with a metal-to-metal joint between it and the liner, by four studs fixed to the jacket casting."* [AMJ 11/02/05]

The IOE valve actuation arrangement was similar to that shown in Austin's 1903 patent No. 6461, but augmented by adjustable-height rocker pivots to give variable inlet valve lift, which could be altered by the driver to control engine speed. The variable lift mechanism was subject to another patent, No. 16436, by Silverman (Crayford Works) and Brown (Adderley Park) dated August 1905 [Painting p33/34].

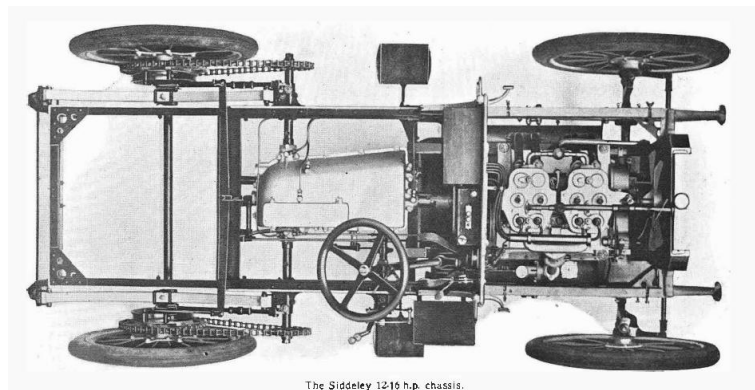


To digress, the first Mercedes - the 35hp of 1901 - set the pattern for engine design copied by many over the next decade. The Maybach-designed 4-cylinder 'Simplex' engine had iron cylinder blocks cast-in-pairs with integral heads, mounted on an aluminium crankcase. Most notably however, the inlet valves were mechanically operated, via a second camshaft on the opposite side of the engine, giving a T-head arrangement. Abandoning atmospheric inlet valves allowed highly responsive engine speed control for the first time, achieved by a variable inlet valve lift mechanism. Mercedes and its imitators soon changed to the simpler alternative of control via a throttle valve in the induction pipe. However, Wolseley favoured variable inlet valve lift, and persisted with this complex arrangement for about 3 years. This seems slightly ironic when the horizontal engines had provided the driver with engine speed control via an induction throttle at a time when many engines were governed to run at constant speed.

From Austin's 1903 patent 6461<sup>1</sup>, showing a mechanically operated inlet valve over a side exhaust valve [Painting p31].

Note that the previous (1903) Siddeleys were almost certainly rebadged Peugeots [Clausager p74], and their Mercedes-inspired T-head engines did not influence subsequent engine design.

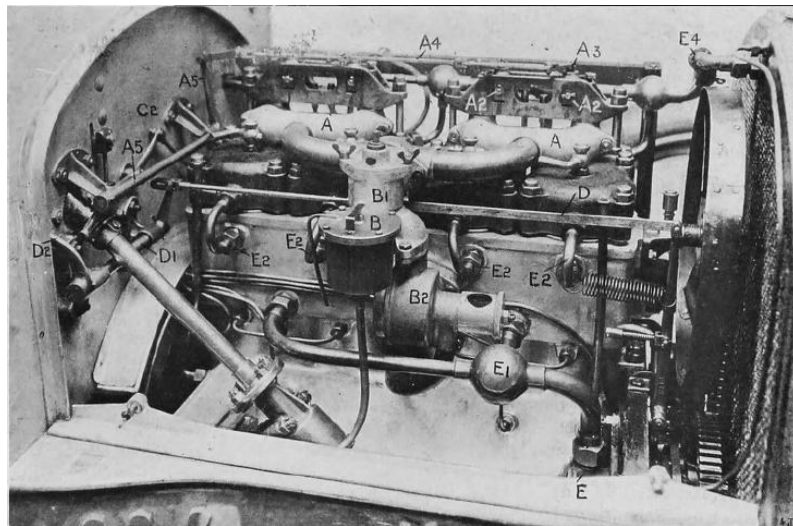
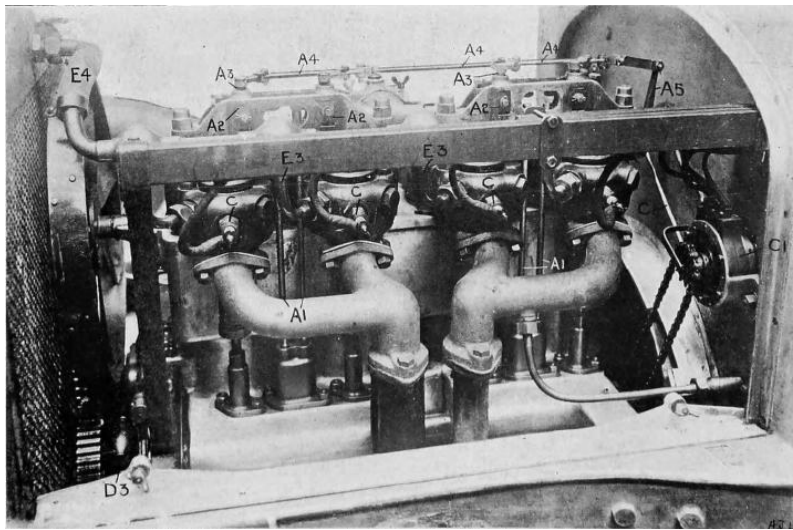
*A 1903 4 cylinder Siddeley 12/16, clearly showing the T-head engine*  
[TA 07/02/03]



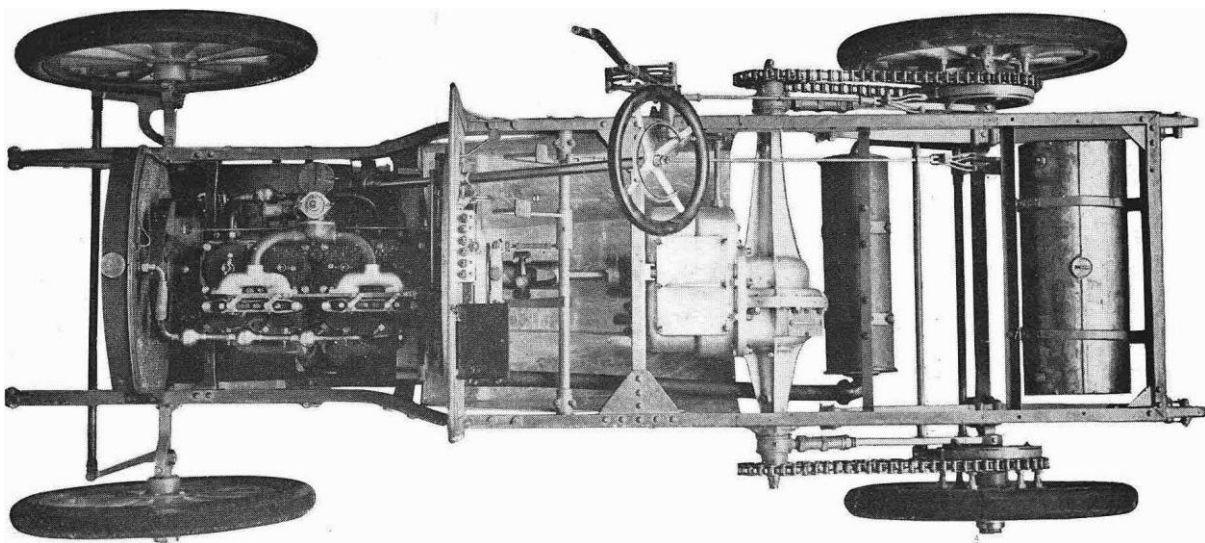
<sup>1</sup> Although published in the horizontal engine era, presumably this was intended for a vertical engine (Wolseley claimed –plausibly – that valves had to be vertical to avoid guide wear [1902 Handbook])



## Wolseley's first vertical four: the 4" 1904 Siddeley 18hp



*4" square (3295cc) 18hp engine elevations showing aluminium monobloc, individual detachable cylinder heads, and IOE valves [AMJ 13/02/04]*



*18hp chassis plan view [TA 13/02/04]*



For 1906, the previous 4"x4" 18hp engine now powered the 15hp model, with normal running speed of 1000rpm and maximum power 18bhp. The new 18hp had an increased bore (4.25"), but was otherwise similar, power output peaking at 22bhp [May 1906 catalogue]. For 1907, yet another 18hp variant appeared, this time with a live axle and 4"x4.5" bore and stroke, delivering 24bhp, but this engine was a very different engine design. It was an L-head side valve with cast-in-pairs iron cylinder blocks, integral heads and separate aluminium crankcase. There were 3 main bearings. The pair-cast L-head side valve would soon become the industry norm, and this architecture was produced in one form or another by Wolseley up to the mid-1920s. Compared to a T-head, an L-head has less dead space in the combustion chamber allowing higher compression ratios – at the expense of constricting the valve diameter – and of course only required one camshaft.

Wolseley modified its L-head formula for the 4 cylinder 12/16 model announced in the autumn of 1909 by using a cast-iron monobloc with inclined valves. It might be that Wolseley had avoided iron monoblocs previously due to the danger of thermal stresses causing cracking of larger castings during use [Daniels]. It has been suggested that this engine inspired the well known Sunbeam 12/16 unit introduced in 1911 [Heal]. In the period 1910-1914, Wolseley were at pains to promote the smoothness, reliability and flexibility of their engines, in comparison with the new-fangled high speed engines peddled by the likes of Talbot, Vauxhall and Crossley. Wolseley's big change would not come until 1920 with the introduction of the overhead camshaft engines, their first which relied on the use of a head gasket (... a tricky technology pioneered by Ford in the Model-T [Daniels]).

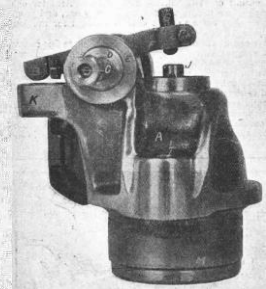
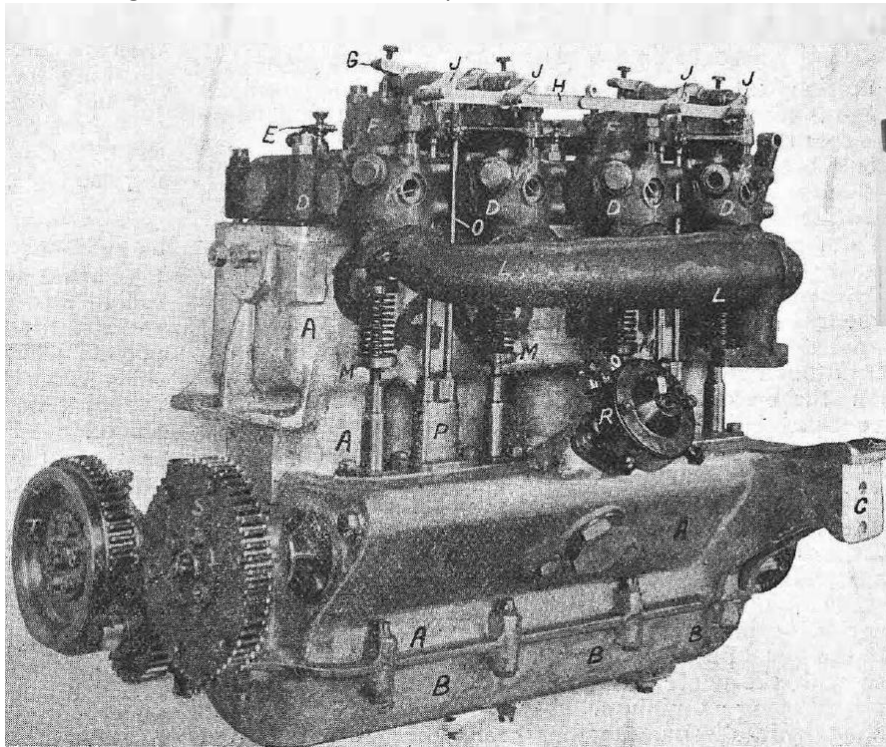


*Car 2022, a 4.25"x4" 18hp dispatched as a chassis on 6/3/1906, and restored 2016-2021.*



## Revised 4" engine: the 1905 Siddeley 15hp

The classic 4" square dimensions of the 1904 18hp were perpetuated from autumn 1905 in a revised engine now denoted as the 15hp. The main difference was a modified variable inlet valve lift mechanism using eccentric rocker fulcrum pins.

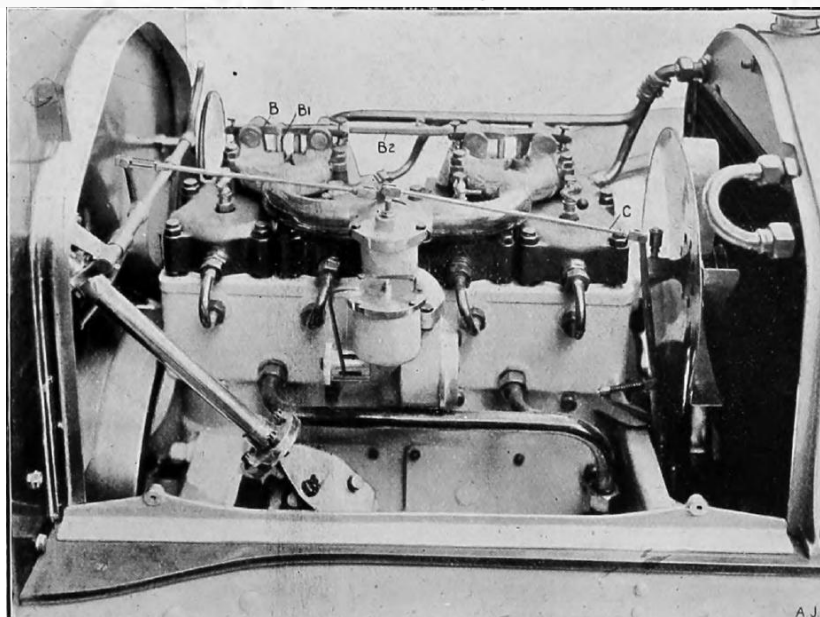


Inlet valve  
rocker

[TM 14/11/05]

### 15h.p. four-cylinder Siddeley engine.

A, aluminium cylinders (four in one casting) cast integral with top half of crank case. B, base of crank chamber, acting as oil retainer only, crank shaft being bolted to upper portion. C, supporting arm cast integral with A. D, cast iron cylinder heads. E, compression release tap. F, cages carrying inlet valves and actuating rockers. G, rockers with adjustable tappets for inlet valves. H, slide for variable inlet lift connected to squared ends of rockers. J, squared ends of rocker shafts. K, entries for ignition plugs. L, exhaust pipe. M, exhaust valve stems and springs. O, tappet rods for inlet valves which actuate tappets G. P, detachable guides for tappet rods. R, distributor for high tension magnets, driven by skew gear. S, half time gear wheel for cam shaft actuating inlet and exhaust valves. T, half time shaft for pump and spring controlled governor.



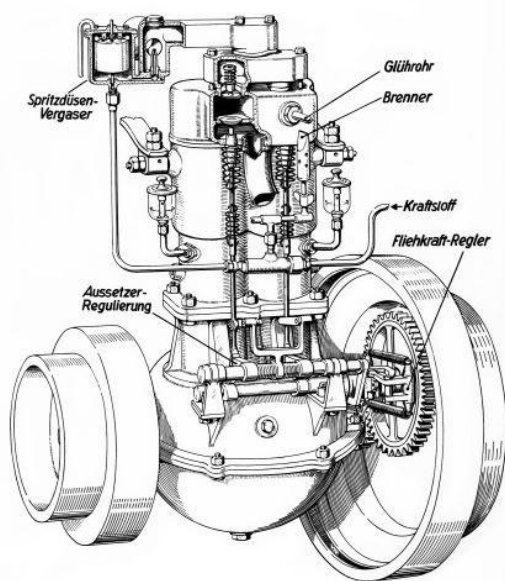
A J [AMJ 2/12/05]

### 3. Napier Engines

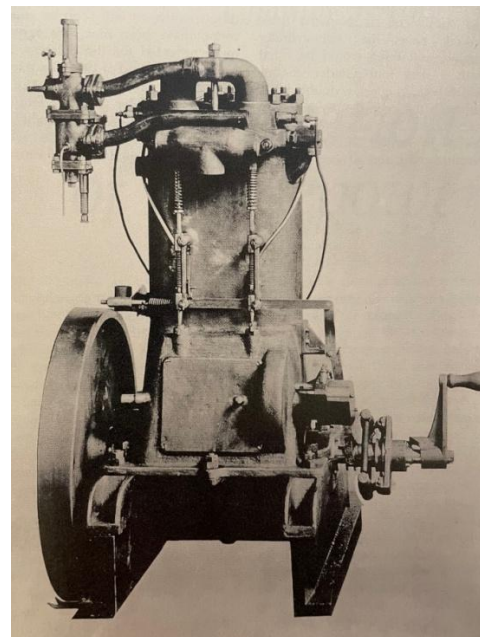
The Siddeley engines introduced at the beginning of 1904, unlike those from many other manufacturers, were not similar to the Mercedes T-head design. Instead, as well as having some of the same unusual features as their horizontal forebears, they bore a distinct resemblance to Napier engines.

To see how Napier engines evolved, let's go back to the dawn of the motor industry. Daimler in Germany and their licensee Panhard et Levassor France, were both manufacturing vertical vee-twin engines in reasonable quantities from 1890, powering their own cars and the first Peugeots from that time. This engine was superseded by the highly successful Daimler/Panhard Phénix engine in 1895. Designed by Wilhelm Maybach, it was an IOE vertical inline twin with a jet carburettor, although still with hot tube ignition (or a 'glührohr', glow tube). This general configuration inspired many other companies, including De Dion-Bouton who became the largest engine manufacturer for a time.

Chief competition in the early days was the horizontal engine as used by Benz. The pace of development was a little slower, with ever larger single cylinder units eventually being joined by inline and horizontally opposed twins, in 1897/8 (see Appendix). Benzes benefitted from electrical ignition (by coil) from the start. Many other companies did adopt the Benz horizontal engine approach, but by 1900 Benz production output was falling [Posthumus, p41], and the vertical front engine format (the 'Panhard System') started to prevail.



© Daimler Benz



Napier Power Heritage Trust

*Daimler Phénix engine (left) of which the first Napier engine (right) was to some extent a copy [Venables p17]*

One of the Panhards which competed in the October 1896 Paris–Marseille race was bought by Selwyn F Edge, manager of the Dunlop Pneumatic Tyre Company. In 1898 he asked Napier to make some modifications to 'No. 8' as it is known, such as converting it to wheel steering. A once large engineering firm known for making printing and stamping machinery, by the 1890s D. Napier and Son had shrunk to a handful of men [Venables]. In 1899 Montague Napier designed a new engine for



the Panhard. This was a vertical inline twin, very much along the same lines as the original Panhard/Daimler Phénix engine, with a cast iron block and 180° between crank throws requiring an uneven firing pattern. As a novice designer compared to Maybach, it seems unlikely that this engine would be a big step forward, but Edge claimed it both started better and pulled more strongly. The biggest improvement was probably the electrical ignition, replacing the outmoded hot tube, an improvement that Daimler itself had introduced the year before. However Napier used coil ignition, rather than the newly invented Bosch Magneto of the Daimler. This 8/9hp engine was the basis of Napier's first production units in 1900.

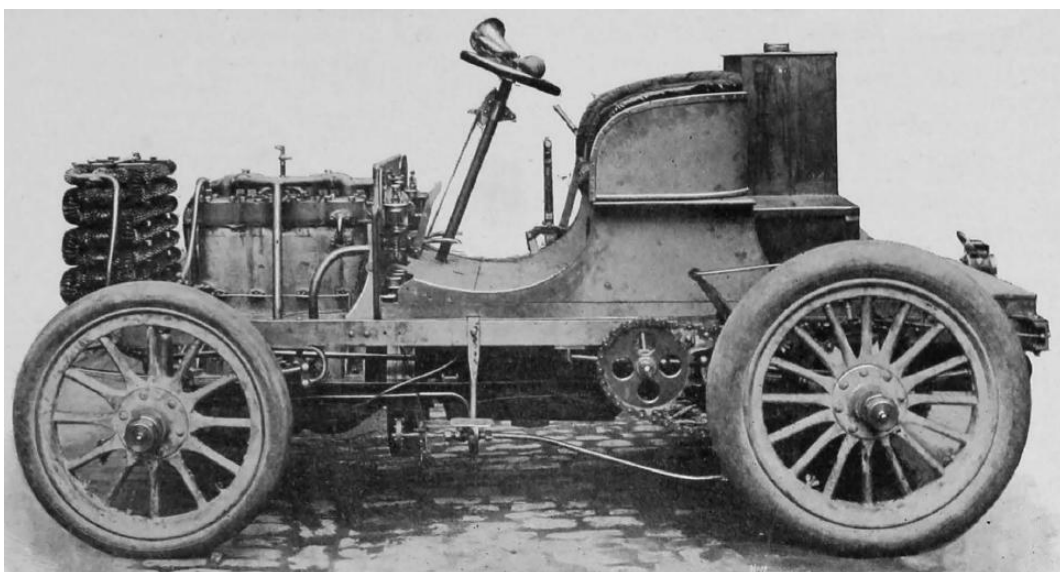
Napier made a remarkable design leap by introducing the 4-cylinder 16hp model in mid-1900. Although described as being founded on the general lines of the Panhard car [TA 07/07/00], its engine seems quite original. It had 4"x6" bore and stroke like its two cylinder forebear, with electrical ignition alone (...a step too far for The Autocar *"the stand-by tube ignition has, we think unwisely, been omitted altogether"*). The Autocar continues:

*"The whole of the body of the engine is made in one aluminium alloy casting, the cylinders themselves being cast iron liners driven in from the explosion chamber ends. The water circulation is distinct as to the water jacket around cylinders and the water around the explosion chambers. .... A Phénix type carburetter is used."*

A later description states that the heads for each pair of cylinders are cast separately, these having a flat ground joint between them and the liners (and mentions both electric and tube ignition ... so perhaps The Autocar were right!) [AMJ 17/05/02]. These engines retained atmospheric inlet valves positioned over side exhaust valves.

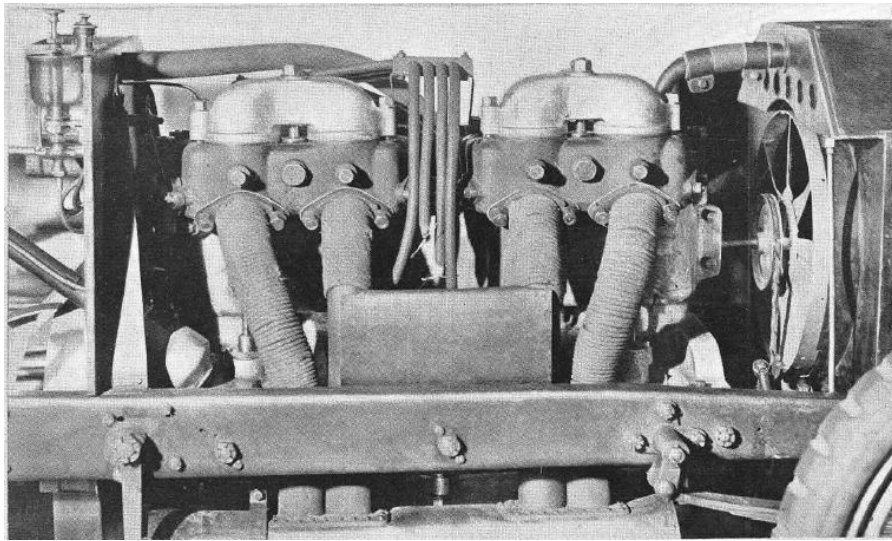
The issue of cylinder orientation aside, these features are remarkably similar to the horizontal Wolseley engines which were by then in production, albeit in single and (just) twin cylinder form. I presume all production engines were aluminium and just the prototypes were in gunmetal or bronze, but can't be sure.

Contemporary concerns about the wisdom of mixing liners and blocks made from different materials given the difference in thermal expansion coefficients [AMJ 14/06/02] proved unfounded, or at least Wolseley and Napier designs accounted for this (... aluminium expands linearly at about twice the rate of iron, so opening up water leakage gaps was a genuine danger). Perhaps this concern dissuaded other manufacturers from adopting the same approach, despite the weight advantage of using aluminium.

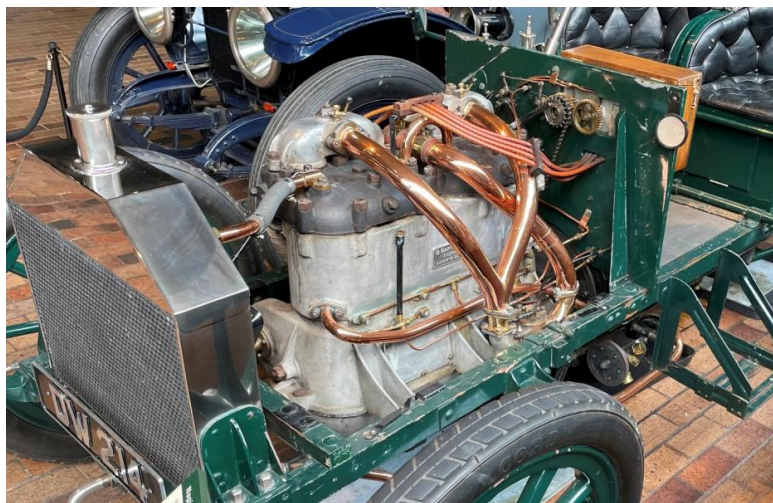
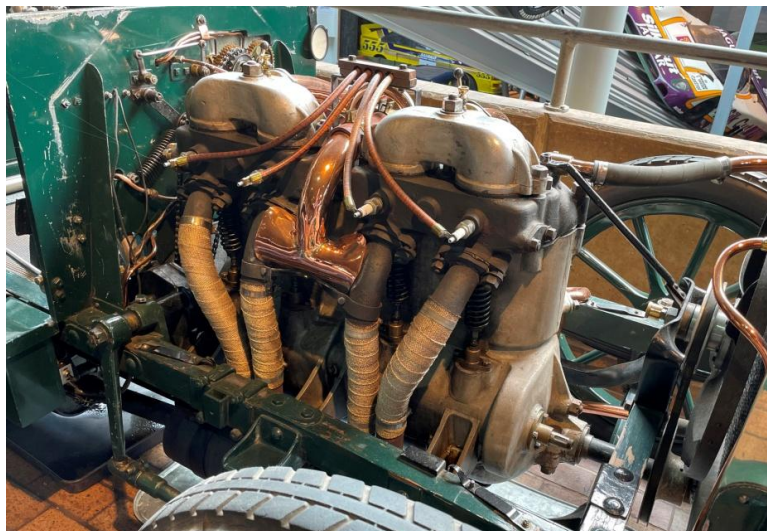


*Napier's first 4-cylinder: the 1900 16hp Napier (4942cc) [TA 07/07/00]*

### 1903 50hp Napier



*The 50hp Napier E61 which competed in the 1903 Gordon Bennett race in Ireland had largely the same engine architecture as the 1900 16hp [TA 04/07/03]. Bore and stroke were now 5.5" and 5", giving 7787cc [Venables, p45,50]. Unlike Wolseley practice, the cylinder heads are paired.*



*This is Jarrott's E61, now in the National Motor Museum at Beaulieu. Note the wooden chassis – primitive compared to Wolseley's use of pressed steel right from the start.*

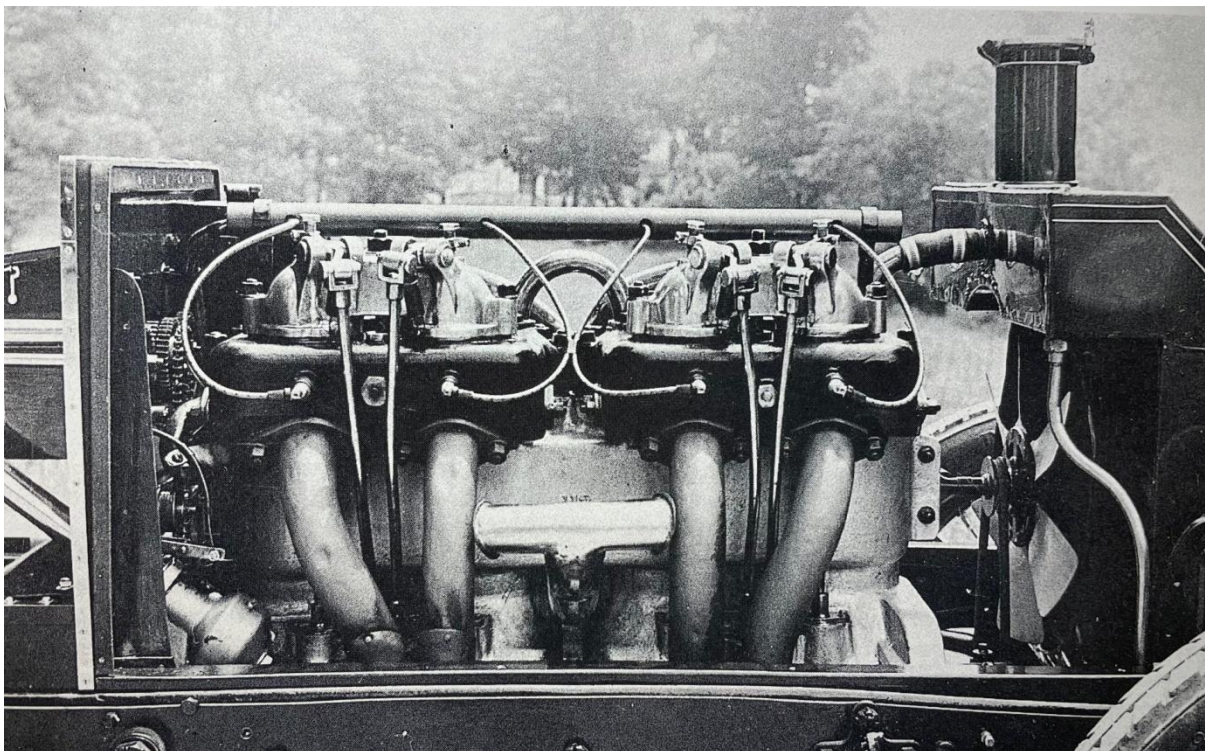


A key engine design change had been made by early 1904 – Napier introduced mechanically operated inlet valves. Still with inlet-over-exhaust positioning, the inlet valves were actuated from the single camshaft via pushrods and rockers. This was in fact the same arrangement as used by the victorious 60hp Mercedes in the 1903 Gordon-Bennett race, Mercedes having temporarily departed from its T-head design.

The intention to produce a 6 cylinder was announced by Edge in October 1903, and it materialised in early 1904. This also had pushrod-operated overhead inlet valves over side exhaust valves, but with cast-in-pairs fixed-head cylinder blocks on a separate crankcase. By this stage paired cast iron cylinder blocks were used by Napier for various smaller engine sizes, including the 12hp since the beginning of 1903, and the 15hp.

Meanwhile in Birmingham, the Wolseley design staff were put to work creating the first generation of original Siddeley Cars, with vertical aluminium engines. As described earlier, the new range were a single, twin and four cylinder of 6hp, 12hp and 18hp respectively. The 18hp emerged in January 1904, and adopted pushrod/rocker operated inlet valves just like the Napiers which appeared at almost exactly the same time. The design similarities are striking, but Napier were actually just moving away from aluminium monoblocs for production engines, as Wolseley would 3 years later.

There is a connection between Napier and Wolseley engine design through Arthur Rowledge. He is credited with the detail design of all Napier engines from 1901 [Venables, p30], but left Napier for Wolseley early in 1905 [Venables, p79]. Perhaps he drove the move away from the aluminium monobloc to the pair cast iron L-heads of 1907 onwards.



*Mayhew's 1904 Napier K5 racer (now in the Louwman Museum), with mechanically-operated overhead inlet valves, and 6.5"x 6" bore and stroke (13051cc) [Venables, p59]*



## References

AMJ: The Automotor Journal

Clausager, A.D., 2016, *Wolseley: a very British car*, Herridge & Sons, Devon.

Daniels, J., 2002, *Driving force: the evolution of the car engine*, Haynes, Somerset.

Heal, O. 2020, *Louis Coatalen*, Unicorn, London.

JSA: O'Gorman, M, 1904, Popular Motor Cars, Journal of the Society of Arts

Lambert, Z.E., Wyatt, R.J., 1968, *Lord Austin: the man*, Sidgwick & Jackson, London. (Note: Zeta Lambert was Herbert Austin's daughter)

Montagu, 1965, *The Gordon Bennett races*, Cassell, London.

Painting, N, 2016, *The real Wolseley: Adderley park Works, 1901 to 1926* (2<sup>nd</sup> Edition)

Posthumus, C, 1976, *First cars*, Phoebus, London.

TA: The Autocar

TE: The Engineer

TM: The Motor

Venables, D., 1998, *Napier: the first to wear the green*, Haynes, Somerset.

Useful links:

<https://mercedes-benz-publicarchive.com/marsClassic/en/instance/ko/Passenger-Cars-and-Vans.xhtml?oid=4146>

<http://peugeot.mainspot.net/models1.shtml>

<http://www.peugeot.com/en/history/a-century-of-models/1900-1910.aspx>

## Appendix 1: Detailed description of Wolseley horizontal engines

Reproduced from AMJ 17/05/02

*The standard types include 5-h.p., 10-h.p. and 20-h.p. cars, each of these being fitted with engines having cylinders 4 ins. diameter by 5 ins. stroke, and being of the single-cylinder, double-cylinder, and four-cylinder types respectively. In addition to these there is also a 7.5-h.p. vehicle with a pair of cylinders 4 ins. bore by 4 ins. stroke, this having been introduced in consequence of the demand for a double-cylinder engine of this lower power. ... The main features of all these cars, as is well known, are that the engine is placed in front beneath the bonnet, that the cylinders lie horizontally, that a large main friction clutch is fitted in the flywheel, that a Hans Renold chain transmits the power to the change-speed gear, and that side chains pass to sprockets on the rear wheels.*

*The engine is built up with an aluminium crank chamber made in two parts, the upper portion of which also forms the water-jacket of the cylinder itself. This aluminium casting carries the bearings for the crank shaft, which are so arranged that the lower part of the crank chamber can be removed without disturbing them. The cylinders themselves are cast-iron liners which are forced into the jackets. Red-lead and asbestos joints are formed at the crank-chamber ends of the liners, and ground conical joints at the outer ends. The cylinder heads are separately water-jacketed and are bolted in place by the same bolts which hold the liner in the jacket, separate nuts being used for each of these duties. A ground joint is also made between the head and the liner, this also being of the conical type. The cam shaft is carried in the lower portion of the crank chamber, the spur wheels driving it being also entirely encased within it. At the lowest part of this casing a drain-cock is fitted to draw off the waste oil. The cam shaft is fitted with a sliding sleeve, which brings half-compression cams into play for facilitating starting the engine. Rocking levers transmit the motion of the cams to the exhaust valves. These levers pass through the crank chamber, and are ingeniously fitted with half bushes about their pivoted points, which makes them air-tight, so that the oil from the crank chamber cannot flow with any freedom past them. This is one of the neat details of which so many examples are found in the Wolseley designs.*

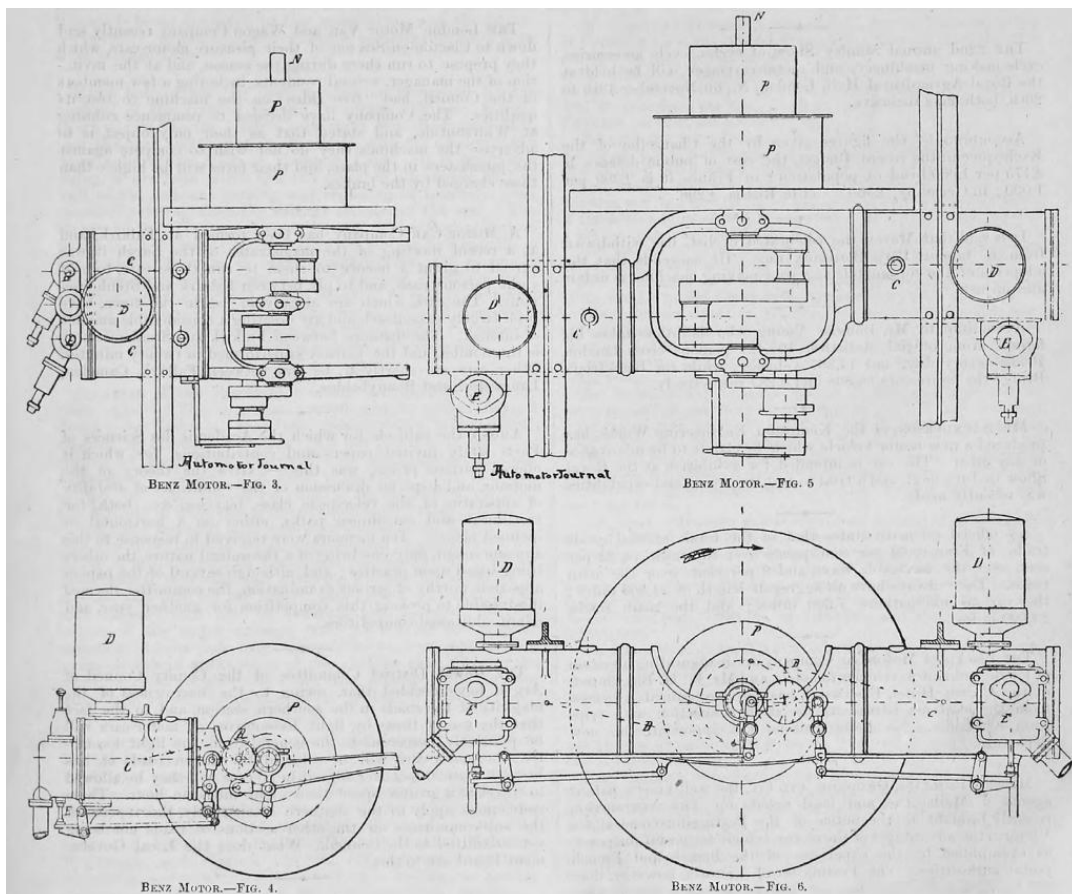
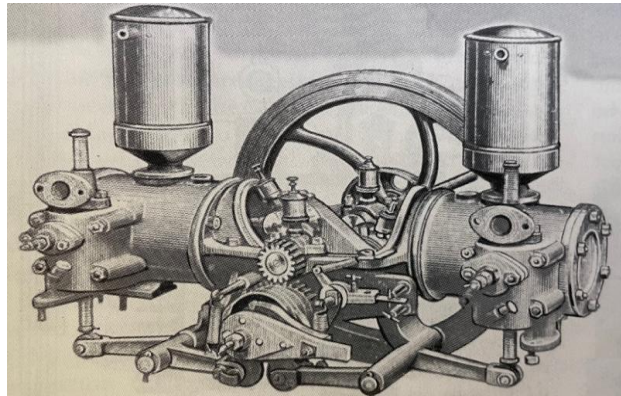
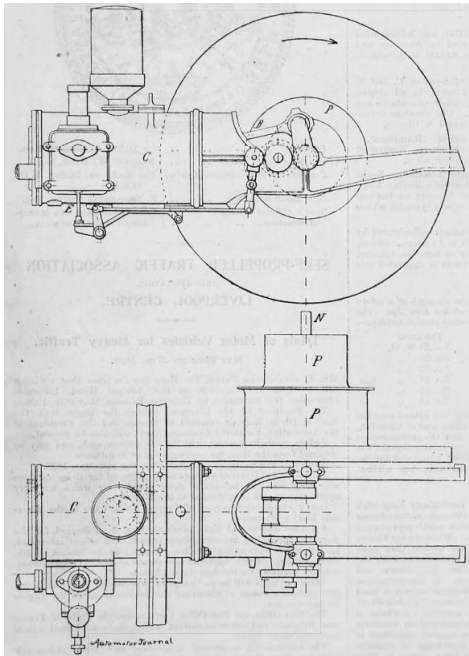
*No automatic governor is fitted on any of the engines, but a double throttle valve formed with sliding valve plates, the one behind the other, is provided in the inlet passage leading from the carburettor to the induction valves. One of these throttle plates is connected with the brake lever in such a manner that when the brake is applied the speed of the engine is reduced to a certain extent, the minimum opening being so calculated as to allow the engine to continue running, although slowly. The other throttle slide is connected with a hand-lever on the steering pillar, and enables the driver to regulate the amount of mixture passing to the cylinder from a maximum down to zero, and to thus control the engine speed. The inlet valves, together with their seatings, are arranged so as to be easily removable. The castings containing them are flanged to take two studs. To remove them it is only necessary to take off two nuts, and to loosen two others, the latter being those which secure them to their mixture supply pipes. These valves are fitted with a special silencing arrangement which prevents the tapping action of the valves on their seats from being heard, and which also lessens the wearing action.*

*The pistons and the connecting rods are of somewhat unusual construction, inasmuch as the gudgeon pin is formed in one solid drop forging in one piece with the connecting rod itself. It is hardened and ground and it projects on either side of the small end of the connecting rod proper. Each end of the gudgeon pin is carried in a hardened steel sleeve, which is forged in one piece with a shank passing through the head of the piston and secured in place by a nut outside it. These two sleeves in which the gudgeon pin works are, therefore, bolted separately to the piston head. One of the chief advantages gained by this construction is that the walls of the piston can be cast of an equable thickness instead of having the usual thickened bosses which are usually necessary for holding the gudgeon pin, the drawback to the usual practice being the tendency to twist out of shape owing to the unequal expansion of the metal when heated. The nuts which hold the steel sleeves in place inside the piston are rounded over in order to avoid any sharp corners in the combustion chamber, and are also slightly riveted in order to prevent them from shaking loose. The outside of the piston is provided with oil grooves in much the usual manner, and these communicate with two small copper pipes, leading through the wall of the piston and passing to each of the steel sleeves. Each piston has three rings. These are made of cast iron, and are pinned.*

*The crank shaft on these engines is made of a solid forging, and is an excellent piece of work. On the double-cylinder motors the two crank pins are in line with one another. These crank pins are lubricated in an ingenious manner, a groove being cut in the solid metal outside the crank cheek and near to the bearings. A hole is then drilled from this groove into the centre of the crank pin, and the oil which is splashed into the groove is naturally thrown outwardly into the centre of the big end bearing of the connecting rod by centrifugal force. The flywheels are fixed to the crank shaft by means of a flange forged solid with the shaft itself and registering into the hub of the wheel. Absolutely true running is in this way assured, it being impossible for them to be thrown out as they are liable to be if keyed only. The crank shaft bearings on the driving end, particularly of all the Wolseley motors, are extremely long, that on the 10-h.p. engine being 7.1/8 inches. The brasses of the bearings are held in place against the cylinder portion of the crank chamber by means of shouldered bolts. By this construction the lower half of the crank chamber can be removed without disturbing them, although it is held in place by the same bolts which secure the brasses themselves in place.*

## Appendix 2: A contemporary design - the Benz Horizontal Engine

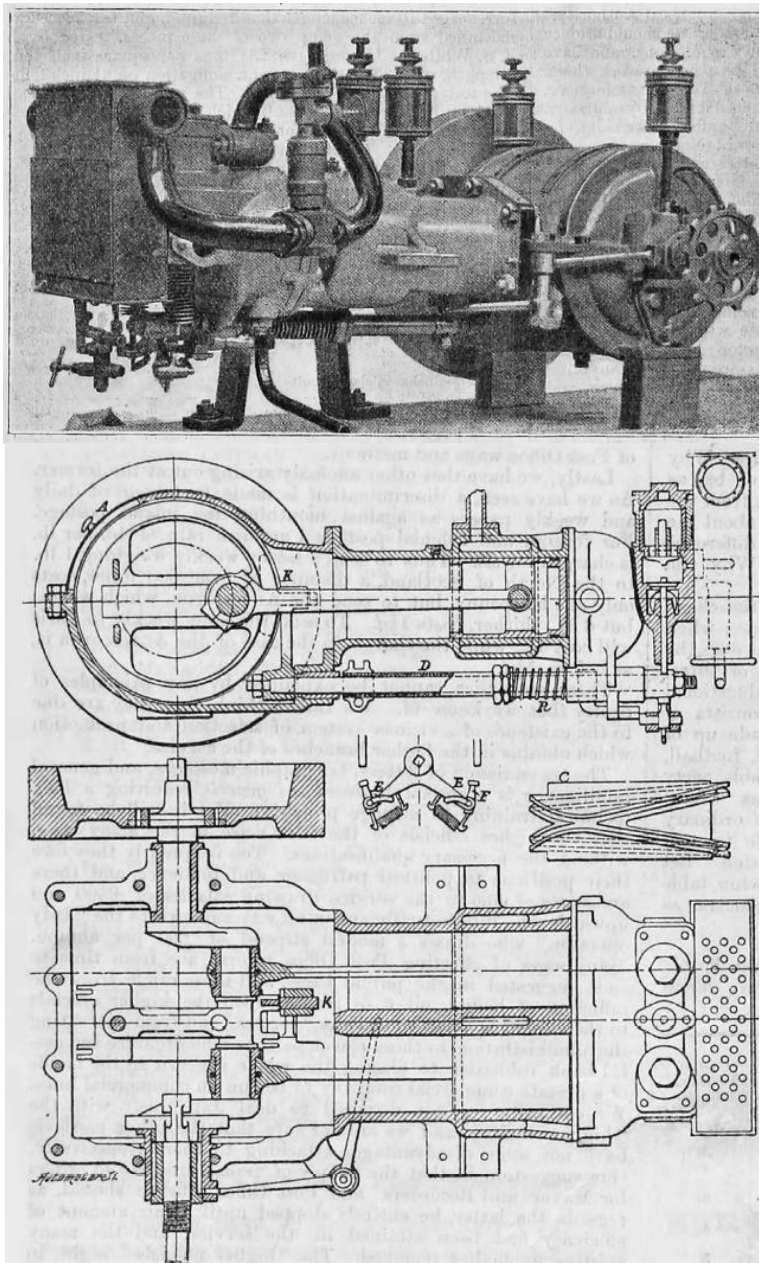
[AMJ 16/05/98]: The single cylinder is the oldest type, the horizontally opposed 'Kontra' 9hp motor is better balanced (right and bottom right) but requires more room and so is most appropriate for commercial vehicles. The inline twin was said to be preferred for cars (lower left). With 180° offset crank throws this required an uneven firing sequence, but provided good reciprocating balance. Coil ignition was used. The gear driven cam shaft opened the exhaust valves via a rocking arm, a pull-rod and a bell crank (somewhat simplified in the 3D sketch of a later version, [Daniels p21]). The crank shaft is exposed, and a cannister of cooling water is perched above each cylinder.





### Appendix 3: Contemporary Peugeot engines

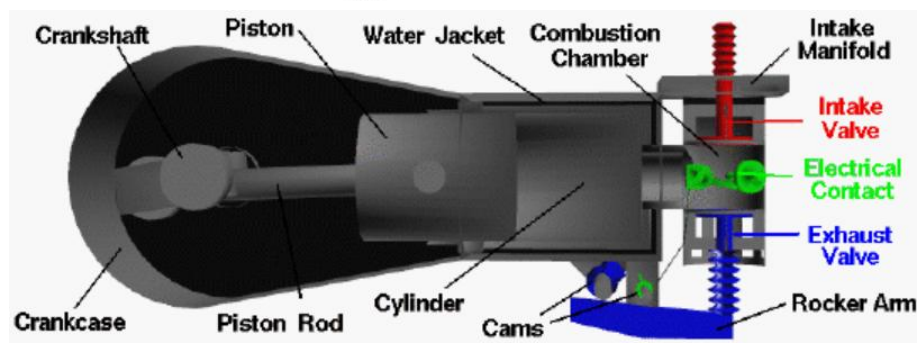
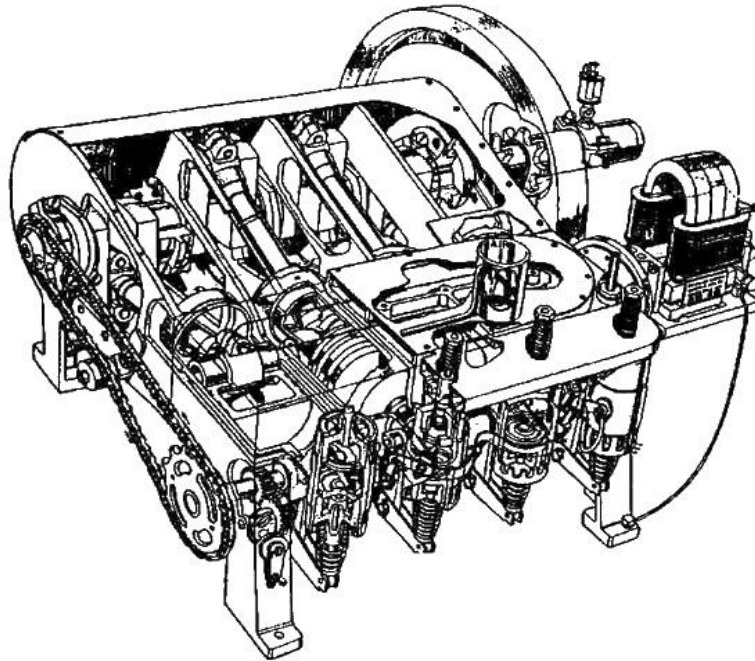
Peugeot used the Daimler-designed vee-twins supplied by Panhard up to 1895, but then decided to make their own engines, rather than adopting the Phénix design. They opted for a horizontal twin, but by 1901 relented, and followed the trend for a vertical engine at the front and shaft drive, the so called 'Panhard system'. This single cylinder 5hp model, type 54, was imported as the first 'Siddeley', its cast iron IOE engine with atmospheric inlet valve was fairly conventional. The first 4 cylinder Siddeley, the 18/24, was probably a rebadged Peugeot 42 [Clausager, p74], with mechanical inlet valves (T-head) and magneto ignition [TA 07/02/03]. There was also a smaller 4-cylinder car, the 12/16, with similar engine design.



*Peugeot horizontal engine. The cylinder head looks detachable, but actually owners are advised to remove the valve chamber cover to allow inspection. Hot tube ignition is employed, and there is an "impulse every revolution". The Exhaust valves are actuated by distributing shaft 'D' which rocks to and fro by engaging with a track 'C' around a drum in the centre of the crankshaft. [AMJ 18/08/97]*

## Appendix 4: Another aluminium horizontal engine – the Wright Flyer

Orville and Wilbur Wright needed a powerful, light-weight engine in 1903. They designed and built an engine themselves with the help of their mechanic Charlie Taylor. It had horizontal cylinders, and aluminium block, atmospheric inlet-over-exhaust valves ... and was altogether very similar to Wolseley's design, but with a chain rather than gear-driven camshaft. They settled on a 4-cylinder in-line configuration for the Wright Flyer, with both 4" bore and stroke, and obtained 12bhp, very creditable for a home-made engine with a primitive surface carburettor and mechanical-igniter spark plugs. The 4"x4" version of Wolseley's 4-cylinder horizontal engine was launched a year later and probably produced about 20bhp. Is it too fanciful to think that the Wrights were inspired by drawings of Wolseley's engine, which were freely available in the engineering press?



Further information:

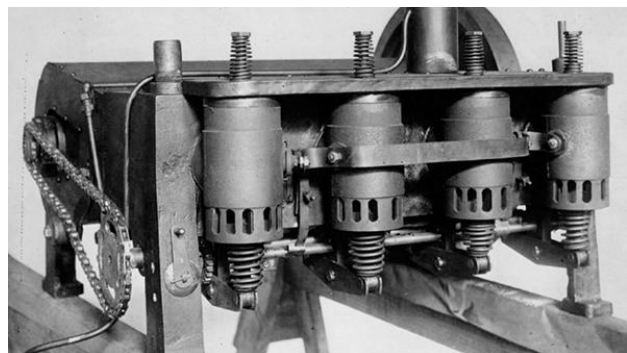
<https://wright.nasa.gov/airplane/eng03.html>

<https://airandspace.si.edu/exhibitions/wright-brothers/online/fly/1903/engine.cfm>

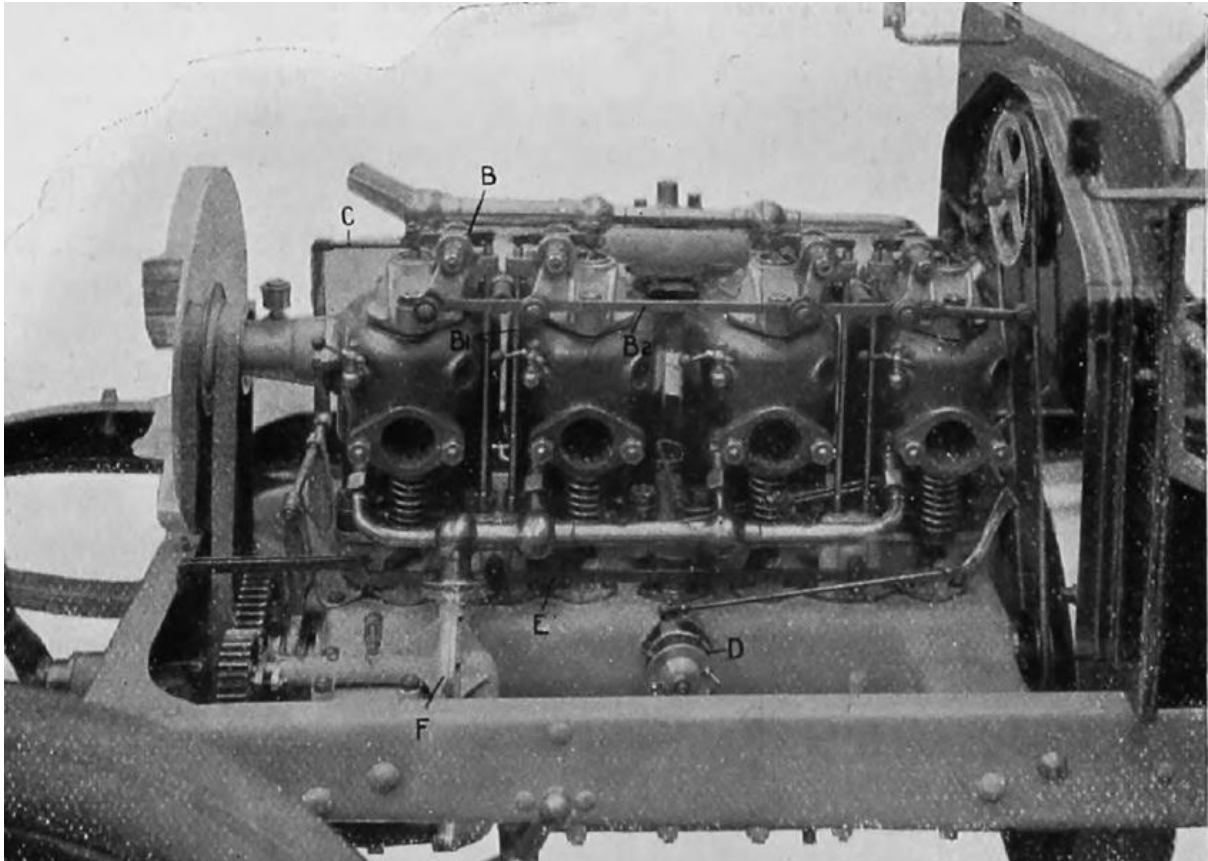
<https://www.centennialofflight.net/essay/Aerospace/earlyengines/Aero4.htm>

<https://www.machinedesign.com/automation-iiot/article/21831683/100-years-of-aircraft-engines>

<https://aviationweek.com/aerospace/milestones-masters-propulsion-technology>



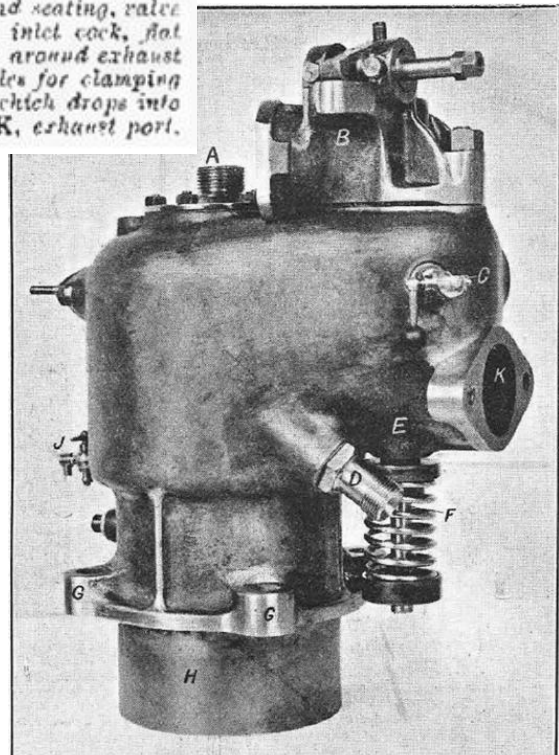
## Appendix 5: 1906 Wolseley 32hp



The 1906 32hp model was a halfway house towards the 1907 L-head design – with individual cast iron blocks, integral heads and separate crankcase, but still retaining IOE valves. [AMJ\_02/12/05]

### One cylinder of the 32h.p. Siddeley engine.

A, water outlet. B, detachable cage carrying inlet valve and seating, valve tappet, eccentric rocker and rocker shaft. C, paraffin inlet cock, flat serving as container. D, water inlet. E, water jacket around exhaust valve stem and seating. F, exhaust valve. G, bolt holes for clamping cylinder to top of crank chamber. H, flange of cylinder which drops into crank chamber top. J, water drain cock from cylinder. K, exhaust port.



[TM 14/11/05]