Note 25

Racing side-valve engines, 1906 – 1914

Renault pioneered the racing Side-Valve (SV) engine in their successful 1902 light car (2, 702).Only once has an SV engine powered a "Grand Prix Car-of-the-Year" (CoY) in the 1906 Renault type AK (see Eg.1 in the 1st Naturally-Aspirated Era). However, the same type of Renault might very well have won the limited fuel consumption 1907 French Grand Prix (FGP)((4), see Eg. 2) so it was not then outclassed completely in comparison with contemporary Overhead-Valve (OHV) designs. This was despite the basic disadvantages that:-

- The inlet and exhaust paths were even more tortuous (an extra 180^0 each of flow turning);
- Valves quarter-shrouded by the combustion chamber wall;
- Combustion chamber with a higher (Surface Area/Volume) ratio with higher heat losses.

Perhaps these factors were not critical while all multi-cylinder engines were then breathing through a single updraught carburetter. There *may* even have been some Combustion Efficiency gain in the SV by the greater mixing of fuel and air via the increased inlet turbulence.

The SV engines of the 1906 – 1914 period had claimed HP/Litre equal to, or greater than, the OHV competition. There must be some reason why they did not have greater GP success despite the simplicity of the type. Certainly a notable result was 3rd, 4th and 5th places in the famous 1912 *Formule Libre* FGP by Sunbeam IL4 3 L SV cars These had been entered primarily in the concurrent Coupe de l'Auto (Cdl'A) for light cars in which they were 1st,2nd and 3rd. They met and defeated decisively the 3 L Cdl'A version of the new 7.6 L DOHC Peugeot which won the GP.

This excellent result encouraged Louis Coatalen, chief of Sunbeam, to enter SV cars in the following year's FGP. The 1913 GP Sunbeam IL6 4.5 L engine was listed at 110 HP @ 3,000 RPM (24), where the winning Peugeot IL4 5.6 L had 115 HP, but the best Sunbeam finished 3rd, 2.6% slower. This was another limited-fuel race and the 1st and 2nd DOHC Peugeots averaged 14% inside the ration so that they had been driven well in hand. The SV Sunbeam was therefore beaten easily. Peugeot also had their revenge with 1st and 2nd in the 3 L Cdl'A race two months later, with improved 3 L DOHC cars, by beating the somewhat-revised SV Sunbeam into 3rd place.

Again, the 1914 FGP-winning IL4 4.5 L SOHC Mercedes is known to have had 104 HP (468) while Laurence Pomeroy was selling for the road Vauxhall 30/98s, IL4 4.53 L, with 95 HP (734). That power was at least confirmed by a post-WW2 test of a rebuilt 30/98 SV engine which showed 100 HP @ 2,800 RPM and 120 HP @ 3,500 (735) (some advantage in that test must have accrued from modern higher-Octane petrol permitting more ignition advance and also oil of lower viscosity).

Why, then, did LP Senior not enter tuned-up 30/98s in the 1914 FGP (reducing swept volume a trifle) but instead go to all the expense of a new DOHC design, alleged to give 130 HP (224) (but (371), more nearly contemporary, quotes 110 HP @ 3,000 RPM – a classic example of the pitfalls awaiting racing engine analysis!)?

A further definite case of SV achievement is that the 1st car in the world to better 100 miles in the hour, actually 103.8 miles (167 km) in February 1913 at Brooklands was the Talbot IL4 4.53 L single-seater with that valve gear, a hotted-up touring engine, driven by Percy Lambert.

Sustainable power

The answer to the query regarding non-success of the SV engine in GP racing must be that the type could not sustain its *initial* power over a sufficient distance (the 1912, 1913 and 1914 FGPs were respectively 1,539, 911 and 752 km). The poor cooling of the exhaust valve, in particular, would probably have led to failure unless the RPM were reduced from maximum power output. In this connection it is known that the 1913 Sunbeam IL4 3 L Cdl'A stablemate of the 6 cylinder 4.5 L GP car was limited in its race to 2,600 RPM, where the maximum power was quoted at 3,000, and the GP cars also raced to a limit, probably the same RPM (24). The Talbot record-breaker ran at only 2,500 RPM although the maximum power was quoted as 130 HP @ 3,500 RPM (i.e. far superior to the following year's Mercedes) and the lower RPM power was given as 100 HP (645).
In the case of the Talbot a parallel reason for a restricted speed was that otherwise the tyres would not last. The post-record condition of the engine is not known

Peugeot quite soon afterwards took the 1 Hour Record up to 106.2 MPH (+2.3%) at Brooklands with a single-seater body on a 1912 7.6 L GP car. That did include a stop to change wheels (645). Talbot would therefore have had an incentive to use their nominally-available extra 30% power to add 9%* to their lap speed if they could do so, also using the tyre-change tactic at some small cost in average. The car *had* been timed over a flying half-mile at 113.3 MPH (737) which is the +9% over their Hour figure which would be expected if the claimed full power was available (a lower back axle ratio must have been used). It rather looks as though the engine could produce 100 HP for an hour but 130 HP for only a few seconds.

When an attempt *was* made by Talbot to regain the 1 Hour Record in October 1913 a tyre failure led to the death of their works driver, Percy Lambert, so the ultimate capability is uncertain.

The question, therefore, of why the SV engine of the 1906 – 1914 period could still *promise* well though only sometimes *achieve* well, is not settled for sure. Lack of really long-distance stamina *is* probably the answer.

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*Brooklands Outer Circuit lap speeds rose with the cube root of Power/Weight ratio, for given body types, up to 135 MPH (732).

Later developments

As knowledge was acquired of how to make OHV engines realise their greater breathing and burning potentials and also as the heat rejection problems were multiplied by post-WW1 supercharging, their advantages over the SV became overwhelming in racing.

For many cheap touring cars the invention by Harry Ricardo of the turbulent (aka “Squish”) head for the SV engine, patented in 1919 (852) provided another 3 decades of life for that type. Ricardo had proved it to add nearly 20% to the peak BMEP on the same fuel and same gross consumption, half of the gain coming from better burning and half from a unit increase in useful compression ratio (852). Laurence Pomeroy Senior was one of the first to introduce the new head to a post-WW1 SV engine (852). Fig.N25A on P.3 shows the 1938 Ford SV V8 with a squish head. It can be compared with a 1911 SV head design on Fig.1D showing a Hispano-Suiza engine (1st Naturally-aspirated Era).

However, on the question of *sustained* SV power, it is interesting that the Ford 90V8 3.6 L SV production engine of 1938 with a published bench-test curve showing a peak 88 HP (365) was thought to be only capable of just half of that *continuously* (736). Of course a touring engine does not have to operate very often – if ever – at full power and it is not designed to do so for cost reasons. The steady rating for the Ford was undoubtedly particularly low because the SV cooling problem was exacerbated by having exhaust ports cored right through the block from the inside to the outside. The low steady power must have been a handicap to the use of this V8 in the WW2 tracked Bren-gun carrier, which needed good cross-country performance. An internal analysis of the engine is given in Sub-Note A.

The “last hurrah” in racing of the SV type, other than in low-cost amateur events and home-built specials, was in the early ‘30s by Lord Austin’s Murray Jamieson-supercharged 750 cc cars on alcohol fuel**. When these were finally defeated by SOHC MGs, Austin financed and Jamieson designed a new DOHC design.

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**Power claimed was 70 HP at 24 psi boost. A copyright photo of a 1934 engine is available at:-
https://www.flickr.com/search/?q=1934+Kay+Petre

then click on ‘1934 Kay Petre’ on flickr

Sub-Note A

1938 Ford V8 Analysis

It is interesting to look at an internal performance analysis of the 1938 Ford 90V8 221 cid (3,621 cc) engine of B/S = 3 1/16'' (77.7875 mm) / 3 ¾'' (95.25 mm) = 0.82, this being a Side-Valve engine with Al-alloy Ricardo-type squish head and dual-choke carburetter. Sufficient data has been published for this analysis to be done, which is quite unusual for any type of engine, although it is not of the standard of Ricardo's 1922 3 L Vauxhall analysis because it is necessary to consolidate the figures from two sources.

	NA, Petrol, at STP	Source
Date	1938	
Make	Ford	
Type	90V8 221 cid	
MDR	1	
V cc	3,621	
NP RPM	3,750	365
R	6.3	365
ASE	0.52	
EV	0.71	594
EC	0.59	From SFC = 0.62 lb/BHP. Hour @ NP (365), known ASE and given EM (594). BThE = 21.4%.
EM	0.7	594
PP BHP	88*	365

*As described in the main text this was a short-time rating.
The "continuous" rating was 45 BHP (736).

Comparison with Renault AK

The figures make a contrast with the one-and-only SV CoY, the 1906 Renault AK. The Ford was about the same Peak Power but obtained this from just over ¼ of the Swept Volume at 3 x RPM and with about 2 units higher Compression Ratio with the Al-alloy squish head on ordinary 1938 commercial Petrol – say 70 Octane rating instead of a (retrospectively-rated) 45 in 1906.

Fig.N25A
Ford 90V8 221 cid