

Ernest Henri and Louis Coatalen, 1912 - 1922

In racing engines, during the period 1912 -1922, Ernest Henri and Louis Coatalen first competed against each other, then Coatalen copied him and finally he employed Henri. This note describes the relationship.

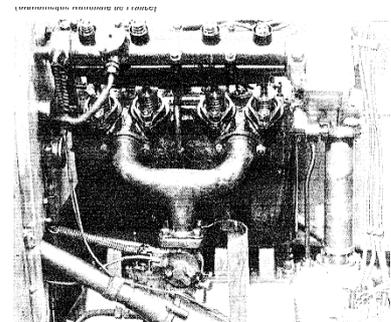
On PP. 4 /5 are shown the engines designed by Henri, first for Peugeot 1912 – 1914, then for Ballot 1919 – 1921 and finally for Sunbeam in 1922.

1912 -1914.

In 1912 Louis Coatalen, Managing Director and Chief Engineer of Sunbeam, entered a team of basically tuned-up side-valve touring cars as “*Voitures Legere*” in the Coupe de L’Auto (C de L’A) to be run concurrently with the Grand Prix de l’ACF (FGP) at Dieppe. The new Peugeot team in the big *Formule Libre* race had been designed by Henri with DOHC and 4 valves per cylinder, and he also produced the design of a new 3 litre for the smaller event (badged as “Lion” to continue the brand of their previous voiturettes). Until publication of DASO 1218 (see References below) it was assumed that this smaller engine was also DOHC and 4 v/c. A photo below shows that it was DOHC but only 2 v/c.

The Sunbeams thrashed the singleton Peugeot, taking 1st,2nd and 3rd places. The Lion DNF with engine trouble. It seems likely that it had suffered inadequate preparation in the effort to finish the Grand Prix cars. The power of the Lion is not known but, as the Sunbeams had 74 HP; presumably it had less.

This Sunbeam success encouraged Coatalen in 1913 to enter both the C de L’A and the FGP, still using side-valve engines. The former were similar 4-cylinders to 1912 with 17% more power and the latter 6-cylinder to the same layout. The Peugeots for both races were completely re-designed and improved by Henri, both now DOHC and 4 v/c.



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This time it was the Sunbeams which were beaten, the big cars in the June GP coming 3rd (2.5% slower than the winner) and 6th with 2 x DNF; the smaller in September also 3rd (3% slower than the winner) and 2 x DNF.

Although Coatalen had designed overhead-valve racing engines in 1910 and 1911, he clearly now concluded that he needed much more modern technology. He took the simplest way to that. The history is detailed in DASO 1086, how Sunbeam “reverse-engineered” a 1913 3 Litre Peugeot hi-jacked from an exhibition tour. Laurence Pomeroy has told the anecdote that, when his father teased Coatalen about this “Chinese copy” which was produced by Sunbeam for the 1914 RAC Tourist Trophy, the Breton replied “*Ah, Pomeroy, it ‘eez a vize man who copies vizout altair*”! Actually, the bore was increased by 3.5 mm, to take advantage of the peculiar TT regulation 3,310 cc limit. Also, although the external differences were concealed by sheet-metal covers at the time (DASO 24 at P.54), one engine was fitted with finger cam followers in place of the rather complicated Henri system for taking cam side thrust (See 1st Naturally-Aspirated Era (1NA) at PP.7 & 8). A team of 4.5 Litre GP cars was also built to the same pattern as the “Henri” TT engine, but to a 7.3% lower S/B than Henri’s 1914 engine and using the finger followers – not quite “*vizout altair*”!

Results were not what Coatalen would have hoped. Certainly the RAC race in June was won, 20 minutes in front of the 2nd place Minerva, but 2 cars DNF (an experimental big-end failure and a seized prop. shaft joint). In the July GP only a 5th place was obtained, 4.5% slower than the winning Mercedes, and 2 cars DNF with a big-end and a piston failure.

In 1914 the C de l'A to be run in September was limited to 2.5 Litre engines. Henri followed the scaling-down principle to design his entry. Coatalen used the much-simpler and cheaper method of fitting a short-stroke crank into his TT engine, it being 117 mm in place of 156. The works test curve for this was given in DASO 24; it was rated at 4,000 RPM to produce 92 HP (below the peak of the curve), the same as the bigger engine rated at 2,800 RPM. The MPS for these engines was 15.6 m/s and 14.6, respectively. The value of BThE was 28% and the EV was 79%. Insofar as a comparison is valid between a genuine test and a report, the Henri engine was 13% less powerful, at 80 HP (DASO 5)*. The Sunbeam would have been heavier, unless the cast-iron cylinder block was shortened (not known). The rivals were never put to the acid test of competition, because the war begun by Germany with Russia on 1st August 1914 caused the race to be cancelled.

*DASO 1218 quotes a test figure for the 2.5 litre Peugeot by the official "*Services des Mines*" as only 71 CV @ 2,920 RPM. On the other hand their figure for the x2 4.9 Litre Ballot was 150 CV @ 2,900 RPM. Pity the motoring historian!

1919 – 1921

After the war Ernest Henri was engaged by Edouard Ballot to design a car for the 1919 Indianapolis 500 miles race, to fill a contract which the 1914 winner, René Thomas, already had to compete. It seems that Henri had already laid out for Thomas a novel 8-cylinder engine based on two of his 1914 2.5 Litre engines, with the bore reduced by 1 mm to meet the then-Indy-limit of 300 cubic inches (4,916 cc) (DASO 1218). Other novelties were:- inverted cup tappets; and enclosure of the valve springs (therefore oil-cooled). The 4 cars were completed in record time, proved to be the fastest at the Speedway, but only secured 4th and 10th places because American wheels, made at the last-minute, failed and caused 2 crashes and enforced speed reductions and pit checks on the survivors.

Undaunted, Ballot competed at Indy again in 1920, with engines scaled-down by Henri to the new limit of 183 cid (2,999 cc) (which would also be adopted as 3 Litres for the 1921 FGP revival). Again fastest, again failing to win when the Ballot leading easily had a partly blocked fuel pipe, so only 2nd and 5th. When raced in the 1921 GP another 2nd place was taken, plus a 7th and a DNF (holed fuel tank). A listed Ballot 3rd place was by a remarkable 2 Litre sports car, also designed by Henri

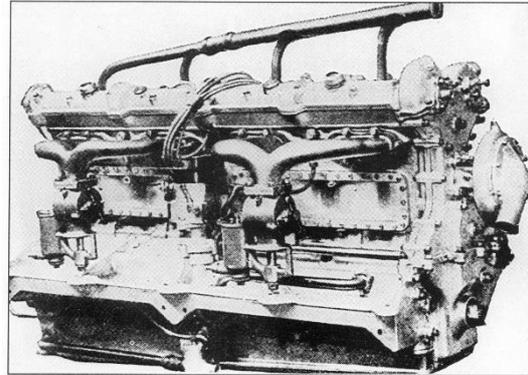
Meanwhile, Sunbeam in 1920 had been amalgamated with Clement-Talbot and Darracq to form the STD group. Coatalen retained his previous posts. The group decided to enter the 1921 GP. It cannot be entirely a coincidence that the engine was 8 cylinders of exactly the same B x S as the 1920 Ballot, or that it had the new inverted cup tappets, which Henri had tried to keep secret in 1919. However, entirely new for an automobile engine was the Al-alloy combined block + head with open-ended steel shrunk-in dry liners, now trusting the alloy to withstand combustion temperature and pressure**. Marc Birkigt had introduced Al-alloy static structure in his 1914 V8 aero engine, but could not let the alloy of the time take this duty, so had used closed-end liners. Coatalen's design therefore pre-dated

the 1925 Rolls-Royce "F" aero engine (wet liners) and the 1932 Alfa Romeo type B GP engine (dry liners) in its reliance on a light alloy head. The war-time research into the material had no doubt permitted this novelty. The Sunbeams should have been lighter than the Ballots, which had cast-iron block + head. Also, their plain crank bearings would have been lighter than the Ballot ball bearings.

The 3 litre STD cars were not ready for the 1921 GP, the entries of all 7 were cancelled, then resurrected at the last moment for 4 cars. They suffered tyre trouble and 5th was the best result. The 3 Litre did redeem itself by winning the 1922 RAC Tourist Trophy. An illustration of the type is given below (RHS. LHS, 1919 Ballot No. 1003).



Photo courtesy of Eddie Berrisford



DASO 24

That the basic design was not at fault was shown by the racing history of the 4 cylinder 1.5 litre voiturettes derived from the eight. They became known as the "*invincible Talbot-Darracqs*" (badged as such), since over 1921 and 1922 they won all 11 events in which they were entered.

******That the liners were open-ended is shown by the description in DASO 24:- "*The two lightweight aluminium alloy cylinder blocks had shrunk-in steel liners and screwed-in phosphor-bronze valve seats*" (author's underlining). As three of the 3 Litre cars still exist there must be many people who could confirm or correct this statement. The author hopes one will contact him via "Enquiries".

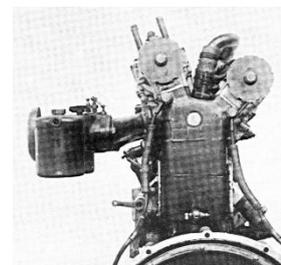
1922

Coatalen apparently was not satisfied with the 1921 3 Litre and *finally* engaged Henri directly to do something better for the 1922 GP, which was limited to 2 Litres. The success of the Talbot 4 cylinder 1.5 Litre perhaps encouraged Henri to return to that number of cylinders. It was probably unknown that FIAT would use 6. He introduced a "lopsided" 4 v/c disposition, 20^o offset for the inlets to straighten out the inflow, 40^o for the exhausts. A 2nd spark plug was inserted under the inlets (see figure RHS from DASO 24).

It was to no avail – the FIATS were faster and all 3 Sunbeams retired with broken valve stems.

This was the end of Ernest Henri as a front-line racing engine designer, after 7 racing years.

Coatalen then once again looked for foreign inspiration. He hired Walter Becchia and Vincenzo Bertarione from FIAT to more-or-less copy the 1922 FIAT for the 1923 GP – which it won, of course. They also redesigned the 1.5 Litre voiturette as a 4 cylinder version of the GP car – and it resumed the winning ways of its predecessor.



THE ENGINES OF ERNEST HENRI and their copies				
1912	1913	1914	1916	
As designer for PEUGEOT				
IL4 7.6 L Grand Prix S = 200 mm/B = 110 mm 7,603 cc S/B = 1.818 DOHC 4 v/c 140 HP @ 2200 RPM	IL4 5.6 L Grand Prix S = 180 mm/B = 100 mm 5,655 cc S/B = 1.8 DOHC 4 v/c 115 HP @ 2500 RPM	IL4 4.5 L Grand Prix S = 169 mm/B = 92 mm 4,494 cc S/B = 1.837 DOHC 4 v/c 112 HP @ 2800 RPM	<div style="border: 1px solid black; padding: 5px;"> The 1912 engine had 5 plain crank bearings, and shaft cam drive. The later engines had 3 ball bearings on a built-up crank, in a barrel crankcase, and spur-gear cam drive.. </div>	
IL4 3 L Voiturette S = 156 mm/B = 78 mm 2,982 cc S/B = 2 DOHC 2 v/c NB!	IL4 3 L Voiturette S = 156 mm/B = 78 mm 2,982 cc S/B = 2 DOHC 4 v/c 90 HP @ 2900 RPM	IL4 2.5 L Voiturette S = 140 mm/B = 75 mm 2,474 cc S/B = 1.867 DOHC 4 v/c 80 HP @ 3000 RPM		
SUNBEAM				
	<div style="border: 1px solid black; padding: 5px;"> Copied from the 1913 Peugeot Voiturette plus 3.5 mm on B towards reaching TT 3,310 cc limit. One engine had Finger Cam Followers. </div>	IL4 3.3 L Tourist Trophy S = 156 mm/B = 81.5 mm 3,255 cc S/B = 1.914 DOHC 4 v/c 92.5 HP @ 2800 RPM	IL6 4.9 L Indianapolis S = 156 mm/B = 81.5 mm 4,883 cc S/B = 1.914 DOHC 4 v/c 156 HP @ 3000 RPM	<div style="border: 1px solid black; padding: 5px;"> Not known how Coatelen got permission to build and race a new car at Indianapolis in neutral USA in wartime. </div>
	<div style="border: 1px solid black; padding: 5px;"> Modified from Peugeot basis in S/B and in having Finger Cam Followers. </div>	IL4 4.5 L Grand Prix S = 160 mm/B = 94 mm 4,442 cc S/B = 1.702 DOHC 4 v/c 108 HP @ 2800 RPM	<div style="border: 1px solid black; padding: 5px;"> To suit Indianapolis 300 cu. inch (4,916 cc) rule </div>	
	<div style="border: 1px solid black; padding: 5px;"> As 3.3 L with reduced S. </div>	IL4 2.5 L Voiturette S = 117 mm/B = 81.5 mm 2,442 cc S/B = 1.436 DOHC 4 v/c 92 HP @ 4000 RPM	<div style="border: 1px solid black; padding: 5px;"> Al-alloy pistons, as advised to Louis Coatelen by Walter Bentley. The 6-cylinder had bad crank vibration at 3,000 RPM. </div>	
Sources for Power figures:- DASOs:- 4,5,24,26.				

1919	1920	1921	1922
As designer for BALLOT			
IL8 4.9 L Indianapolis S = 140 mm/B = 74 mm 4,817 cc S/B = 1.892 DOHC 4 v/c 140 HP @ 3000 RPM	IL8 3 L Indianapolis S = 112 mm/B = 65 mm 2,973 cc S/B = 1.723 DOHC 4 v/c 110 HP @ 3800 RPM	IL8 3 L Grand Prix As in 1920 Tndy.	FIAT IL6 2 L Grand Prix S = 100 mm/B = 65 mm 1,991 cc S/B = 1.538 DOHC 2 v/c 112 HP @ 5,000 RPM Chief Engineer Guido Fornaca
<div style="border: 1px solid black; padding: 5px;"> 1914 Voiturette doubled-up, but B reduced by 1 mm to suit Indianapolis 300 cu. inch rule </div>	<div style="border: 1px solid black; padding: 5px;"> Inverted Cup tappets in Ballots </div>		
SUNBEAM, continued			As designer for SUNBEAM
		May 1921 IL8 3 L Grand Prix S = 112 mm/B = 65 mm 2,973 cc S/B = 1.723 DOHC 4 v/c 108 HP @ 4000 RPM	IL4 2 L Grand Prix S = 136 mm/B = 68 mm 1.976 cc S/B = 2 DOHC 4 v/c 88 HP @ 4200 RPM
	<div style="border: 1px solid black; padding: 5px;"> Al-alloy block/head. All plain bearings. 1 carburetter per 2 cylinders. Inverted cup tappets. </div>	September 1921 IL4 1.5 L Voiturette S = 112 mm/B = 65 mm 1,487 cc S/B = 1.723 DOHC 4 v/c 51 HP @ 4000 RPM	
		<div style="border: 1px solid black; padding: 5px;"> Badged as Talbot-Darracq </div>	

All engines NA on petrol, which would be rated retrospectively at no better than 50 Octane.

Specific Performance							
Date	1914	1914	1914	1916	1921	1922	1922
Make	Sunbeam	Sunbeam	Sunbeam	Sunbeam	Sunbeam	Sunbeam	FIAT
Type	TT	GP	C de l'A	Indy	GP	GP	GP
P/V - HP/Litre	28.42	24.31	37.67	31.95	36.33	44.53	56.25
BMEP - Bar	9.08	7.77	8.43	9.53	8.13	9.49	10.07
at MPS - m/s	14.56	14.93	15.6	15.6	14.93	19.04	16.67
Comparative Performance of 1922 Engines							
	<u>Sunbeam</u>		<u>FIAT</u>		FIAT/S'beam		
BMEP - Bar	9.49		10.07		x1.061		
at MPS - m/s	19.04		16.67		x0.875		
100/Smm	0.735		1		x1.36		
P/V - HP/Litre	44.53		56.25		x1.263 = 1.061x0.875x1.36		

Comparative analysis of 1922 Sunbeam & FIAT

For engines designed on a Volume Specific Power basis the relevant relation is:-

$$P/V \propto [(BMEP) \times (MPS)]/S$$

where, at a given "State of the Art", BMEP is the attainable "stress" in the working fluid and (MPS)² represents the acceptable stress in the reciprocating parts, leaving 1/S to determine P/V.

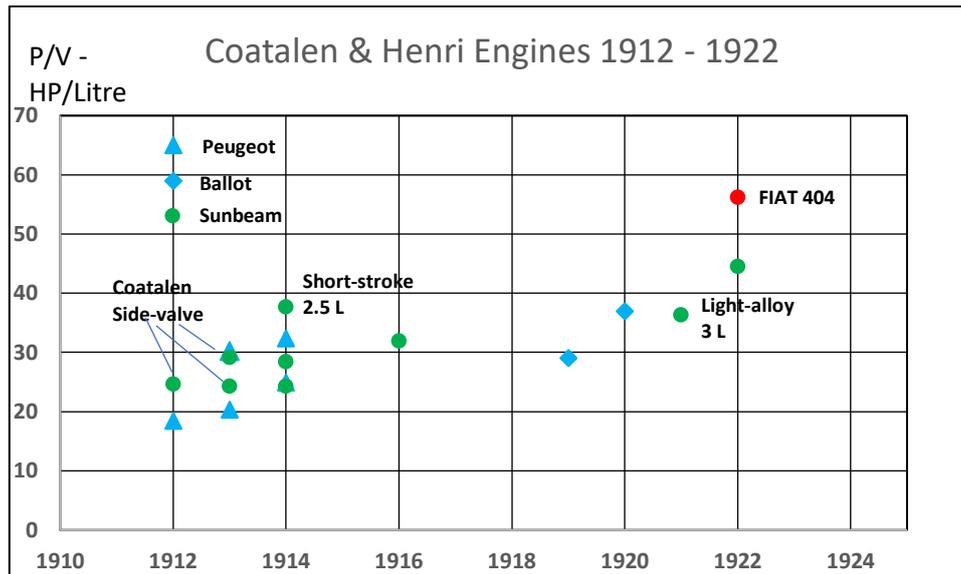
The table above compares the 1922 factors for the Henri-designed Sunbeam with the winning FIAT designed by a team under Guido Fornaca.

BMEP: -FIAT introduced a new 2 v/c hemispherical combustion chamber with (Inlet Valve Area/Piston Area) (IVA/PA) of 0.38, where the Sunbeam had the typical Henri pent-roof chamber with "negative squish" to accommodate over-large 4 v/c with IVA/PA of 0.48. The result was modestly in FIAT's favour.

MPS: - FIAT made a better choice with the materials of the time for a 500 mile GP. The Henri figure of 19 m/s contrasted with the value of 14 which he had selected for his 500 mile Indy engines. In practice, the engines were much more highly stressed than 19 m/s because it was decided to lower the axle ratio to improve acceleration and, coupled with tachometers reading 300 RPM too low (DASO 24), the engines were run up to nearly 5,000, 22.7 m/s or 42% greater stress. Apparently this was discovered before the race, but fatigue life must have been used up; 2 engines suffered valve failures by only 8% distance, although Segrave's survived to 42%. DASO 26 reports Henri remarking bitterly after the race that Coatalen had insisted on some modification which had caused the failures, but his high design stress aggravated by over-revving must share the blame.

1/S: - This leaves the principal *performance* advantage of the FIAT (as opposed to its reliability, *excepting* its axle construction – 2 of those failed) as being a 6 cylinder engine with 36% shorter stroke. Fornaca had chosen to reduce his 1921 IL8 3 L to IL6 2 L with B and S adjustments. Henri could have used the same method but built a highly-stressed 4 instead.

An overview of the Coatalen & Henri engines is given on the chart on P.6 below.



More details of the 1913 3L Peugeot are given as Eg. SO5 in Appendix 1 and Significant Other. The 1920 3L Ballot is Eg. SO6 in the same website references.

Conclusions

Louis Coatalen was a firm believer that "*Racing improves the breed*" by squeezing out complacency from design. He certainly spent the money to put his belief into practice, although it is not known whether this raised sales of production cars. Between 1912 and 1922 Sunbeam racing was in continual relation to Ernest Henri, firstly in competition, then in copying and finally in employment.

In the international sphere, Sunbeam gained a stunning success in the 1912 Coupe de l'Auto (C de l'A) with their side-valve cars, won the 1914 RAC Tourist Trophy with a Peugeot copy and again in 1922 with an engine having Ballot resemblance, competed four times in the Grand Prix de l'ACF (FGP) but did not win it..

Although always prepared to copy, Coatalen *did* introduce innovations:- a bold short-stroke engine in 1914 for a 2.5 litre C de l'A which it might well have won if the German war had not intervened; and a light-alloy engine for the 1921 FGP which was hampered both by inadequate preparation and poor tyres, but at least provided the basis for the "*invincible Talbot-Darracq*" voiturettes of 1921 - 1922.

It awaited the near-copy of the 1922 FIAT before the prize of the FGP was won at the fifth attempt.

Afterthoughts

1. In choosing a shorter-stroke to produce the 1914 2.5 L Voiturette engine, the valve gear had to run at 4,000 RPM instead of 3,000. Nothing is known about how it behaved. The change to finger cam followers probably helped.
2. It will be seen from the Overview chart that Sunbeam 2 v/c side-valve engines had higher P/V than Peugeot DOHC 4 v/c, according to the available data. If so, it is unlikely that the Sunbeam figures were sustainable, because of exhaust valve burning. This subject is discussed further in Note 25.

References

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 DASO 5 Profile No. 73 W Court 1967.
 DASO 24 Sunbeam Racing Cars 1910-1930 A. Heal Haynes 1989.
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 DASO 1218 *Automobile* August 2012 Article by S. Faures Advised by courtesy of Keith Eames.