

Note 28



Fabricated-steel engine construction

The 1st internal combustion engine with fabricated-steel stationary structure was probably that built by Charles Manly in the USA for Langley's unsuccessful aircraft in 1902. This was a water-cooled radial 5-cylinder 5" Bore x 5.5" Stroke, 8.8 Litre design. It weighed only 151 lb (68.5 kg) and held 52 HP for 10 hours in 1904, having 0.76 HP/kg (726). This was achieved after Manly had visited many European firms in 1900 and had been advised they could not make a 12 HP engine under 100 kg, i.e. only 1/6th of the power/weight ratio which he obtained 4 years later. As an aside, it is noted that the Wright brothers, with Charles Taylor, likewise had to build their own aviation power-plant after discouragement by commercial makers. Their cast-Al-body, steel-lined IL4 of 4" Bore x 4" Stroke only sustained 12 HP at a weight of 170 lb (77 kg) (592, 722), 0.16 HP/kg or 1/5th of Manly's engine. Nevertheless, their aircraft was, of course, successful in December 1903. It is a pity that the two groups could not have pooled their knowledge since the Manly had a 40 HP output as early as April 1902. It was not the fault of the engine that the Langley "aerodrome" failed – it crashed twice in 1903 directly after unpiloted catapult launch because of structural weakness.

For comparison, the cast-iron 1902 Panhard racing engine, IL4 13.7 L, produced 70 HP at 0.22 HP/kg, with the non-scaling weight advantage of large size (2, 4).

All the above-mentioned engines had suction-operated inlet valves.

The Manly engine was fully described, with drawings, in a Smithsonian memoir of 1911 (726). The German "Kaiserpreis" aero-engine competition rules were issued in May 1912 and Daimler then entered their DF80 design with fabricated-steel upperworks (468). It seems entirely possible that Paul Daimler had studied the Manly design and added the improvement of welding instead of brazing. Of course, overhead mechanically-opened inlet valves had become normal by then.

The most important users of a constructional system similar to the Daimler's were Rolls-Royce (see Fig. N28A), FIAT and Liberty WW1 aero engines and FIAT racing engines of the early '20s – which were then copied by Sunbeam and Alfa Romeo.

Fig. N28A

1916 Rolls-Royce Eagle Series 1
60V12 4.5"/6.5" = 0.692 1,240.5 cid
(114.3mm/165.1 20,329 cc)
243 BHP @1,600 RPM (later updated to 255 BHP @ 1,800 RPM)
Designed by Henry Royce, assisted by Albert Elliott and Maurice Olley
DASO R-RHT Historical Series No. 43

