Note 141 Colombo and the first Ferrari

A fresh look has been taken at the design by Gioachino Colombo of the first Ferrari to bear that name in 1946. Why did he choose the over-square cylinder dimension and why was it then disappointing in power? This Note 141 discusses these questions and suggests answers.

The Alfa Romeo 158

It is worth recalling Colombo's role in designing the 1.5L Alfa Romeo type 158 – a car which first raced in August 1938 – and won – and last raced in October 1951 – and won then also. In its 8 years of competition it was developed to about double the initial power, partly by Colombo. The origin of the 158 has been discussed in Note 46 as perhaps stimulated by the exploits of Dick Seaman in 1936 with a 1927 Delage rejuvenated by Guilio Ramponi, an old team-mate of Enzo Ferrari, who would have given him full details of that success. At any rate Colombo, on loan to Modena, laid out in 1937 an IL8 engine which followed very much the later pattern of his long-time Alfa chief Vittorio Jano, with a Bore (B)/Stroke (S) ratio of 58 mm/70 = 0.829*. Colombo did introduce the novelty for automobiles of wet cylinder liners screwed at the top into the 1-piece head + block – a feature first used in a 1917 Curtiss V12 aero engine by Charles Kirkham (see "1st Pressure-Charged Era (1PC) Part 2 Part 2"). Undoubtedly this feature helped the power development as the PC rose from 2.2 ATA to 3.9.

*See Appendix A regarding Colombo's initial proposal to design a mid-engined car.

The WW2 years

Of course, the career of the "Alfetta" 158 was interrupted but also assisted by WW2, begun by Nazi Germany with later participation by Fascist Italy. When they were beaten, Germany could not compete in motor racing but Italy, having latterly "Co-operated" with the Allies, could. This was in the new Grand Prix Formula of 1.5L PC or 4.5L Naturally-Aspirated (NA).

It is not known what Colombo did during WW2. No doubt he thought much about his specialist subject. When, in 1946, Enzo Ferrari decided to build cars bearing his own name (being then free from a restriction in his parting from Alfa) and called once more on Colombo to design them, he was ready for the task. One can only be amazed that this project could be brought to fruition in a country raked from bottom to top by a ferocious struggle. If those trying in Great Britain to launch a British Racing Motor ever asked how a war-torn Italy could finance a 158 team, a new Maserati and the intended Ferrari – to say nothing of the Grand Prix Cisitalia – the question was never answered!

The choice of size and configuration for the first Ferrari

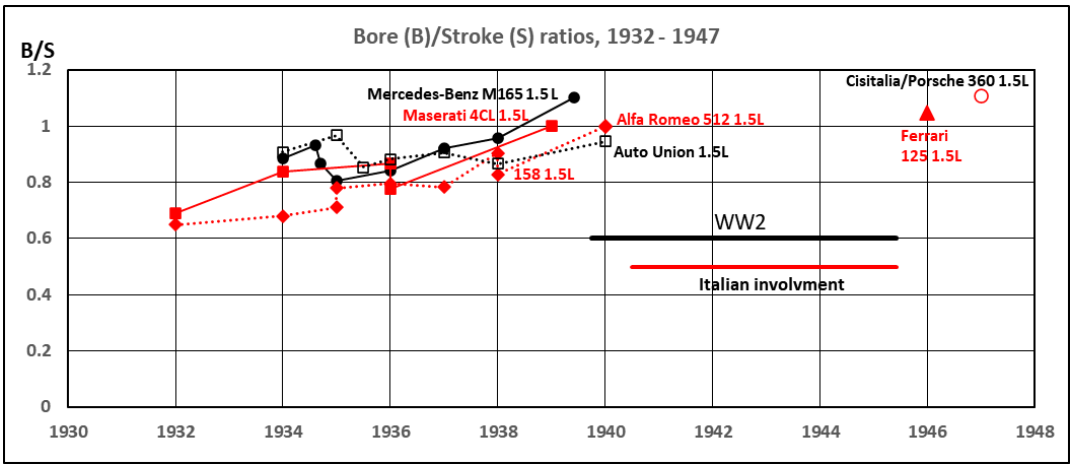
Since Enzo Ferrari always planned to return to the Grand Prix arena one day, the engine size had to be 1.5L for PC. Not having ever raced an NA GP car it is doubtful if he ever contemplated this option in 1946. It would take disappointment with his supercharged attempts and defeats by NA 4.5L Lago-Talbots to change his mind in late 1949

The choice of a V12 was probably also Ferrari's decision – he wrote of his admiration for that configuration. This was actually a bold decision since it meant a cylinder size of only 125 cc (used as a type number, of course). However, he and Colombo would have known about the (despised!) Wifredo Ricart-designed Alfa Romeo flat-12 1.5L of 1940, which had produced 335 CV with 2-stage supercharging (DASO 25).

Bore/Stroke ratio, chosen as 55 mm/52.5 = 1.048, was not quite the stand-out number which many descriptions of the Ferrari 125 have suggested. True, the Grand Prix world had not seen an over-square engine since 1907**, as is often mentioned (the history of B/S for GP "Cars-of-the-Year" [CoY] is shown in Note 21), but actually the tendency to raise B/S had begun in 1936 in Mercedes-Benz. The object, of course, was to raise RPM and therefore power while keeping reciprocating parts stresses at an acceptable level by a given value of Mean Piston Speed (MPS). Fig.1 on P.2 below shows the B/S ratio of racing engines built from 1932 onwards.

**The FIAT winner of the 1907 French GP was IL4 180 mm/160 = 1.125.

Fig. 1



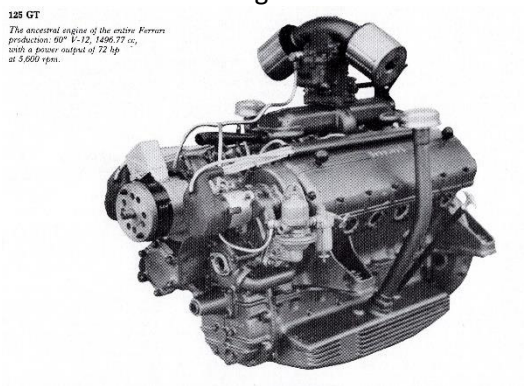
Especially from 1938, when the need for 1.5L units for the potential 1941 formula was considered, all makers had raised their B/S ratios. The 1937-designed Alfa 158, under Jano's influence, had been the last of the well under-square engines. There is little doubt that the severe defeat of his 158 at Tripoli in 1939 by the Mercedes W165 with its B/S of 1.103 had influenced Colombo in considering an over-square configuration for his new Ferrari 125. He probably did not like to think of himself as following in the wake of Ernesto Maserati!

<u>The disappointing performance of the 1946 Ferrari 125</u>

As last raced at Tripoli in 1940 (Italy then at peace), Colombo's PC Alfa 158 had its power peak at 17.5 m/s. Quite likely he expected his NA Ferrari 125 to reach the same MPS, i.e. 10,000 RPM.

When it went on the test-bed in 1946 it could only manage 72 CV@ 5,600 RPM (DASO 22 pp 101 and 122). To quote Laurence Pomeroy about another engine later, "*Faces must have fallen somewhat!".* This was on petrol with a single double-choke Weber 30DCF carburetter (see Fig.2 below) and a Compression Ratio (R) of 8. It was only 9.8 m/s.

Fig.2



DASO 22

It is believed that there were 2 causes of this poor performance:-

- Colombo had chosen to operate the 2 valves per cylinder at 60^0 included angle with only a single overhead camshaft + rockers (SOHC)***. This forced the sparking plugs to the inlet side of the head and to make room for them the inlet ports were siamesed. This was detrimental to Volumetric Efficiency (EV). The plugs also had to be deeply recessed, not conducive to high Combustion Efficiency (EC) (see "<u>Illustrations for Appendix 6</u>" at Fig. 12).

*** See note on P.3.

***SOHC possibly to reduce cost, although as some recognition of the need to avoid valve bounce from limiting the high RPM he *expected* Colombo had used the novelty for a car engine of the Hairpin-spring Valve Return System (HVRS) which was common racing motor cycle practice since the early '30s (see Note 15). Both the Maserati 4CL and the Mercedes M165 had 4 valves per cylinder to balance bottom and top mechanical speed limits.

- The inlet valves were 32 mm head diameter (IVD) so Inlet Valve Area/Piston Area (IVA/PA) was 0.339 and at 5,600 RPM, MPSP 9.8 m/s, the Mean Gas Velocity (MGVP) was only 29 m/s! This was far below the level necessary to give proper mixing of the inlet charge into the cylinder and would have lowered EC (see Note 34) and restricted the RPM (a vicious circle). The MGVP of the1939 1-stage Mercedes M165 (IVA/PA =0.383; MPSP 14.5 m/s) was quite low also, at 38 m/s but, as explained in Note 34, this was acceptable because the supercharger "mashed" the ingoing charge. This would also be the case when the 125 was supercharged for the 1948 125F1 and 7,000 RPM was achieved with MGVP at 36 m/s.

On the *plus* side, the BMEP *was* helped by the low charge inlet velocity reducing pressure losses and the Mechanical Efficiency (EM) was high because the MPSP was so low.

Comparison with the "Old School"

It is interesting to compare the 125 with a good "conventional Old School" engine, as follows:-

Year	1935	1946
Make	Riley	Ferrari
Model	TT Sprite	125
	See Fig. 3 at RHS	
Configuration	IL4	60V12
B/S	69 mm/100 = 0.69	55 mm/52.5 = 1.048
Capacity cc	1,496	1,497
R	6	8
Valve Gear	PushRodOHV	SOHC
Carburetter	2 x SU	1 x Weber double-choke
PP (HP) @ NP (RPM)	61 @ 5,500	71 @ 5,600
BMPP (Bar) @ MPSP (m/s)	6.63 @ 18.33	7.58 @ 9.80

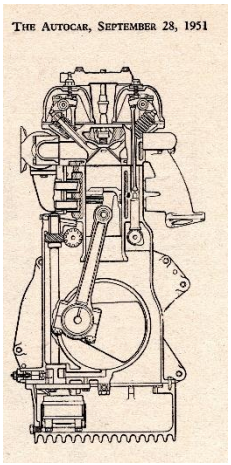


Fig. 3

For a fair comparison the effect of raising the Riley R from 6 to 8 has been estimated as 10%, giving

BMPP	7.32	vs.	7.58

The Ferrari 125 therefore had virtually the same performance as the Riley, although 5 racing years newer. Where it did have an advantage was that the reciprocating stresses, proportional to $(MPS)^2$, were very much lower, as shown below:-

$(MPS)^2$	336	96.

However, the Riley was good enough to win the (handicapped) Ulster Tourist Trophy in 1935 (478 miles) driven by Freddy Dixon and again in 1936 (410 miles) with Dixon and Charlie Dodson. The Ferrari's biggest success was after enlargement to 2L 60 mm (+8.1%)/58.8 (+12%) = 1.020, when Luigi Chinetti won the 1949 Grand Prix d'Endurance 24 hours at Le Mans (driving all but 1 hour). This was, and still is, the smallest size of NA engine to gain that event (the 2L Renault winner in 1978 was Turbo-Charged).

Further enlargement with the same block dimensions was possible and was exploited to 3L 73 mm (+32.7%)/58.8= 1.241 in 1958 for the Testa Rossa. This was a triple Le Mans winner (1958, 1960, and 1961). DASO 138 reported that cylinder centres and bearing sizes were the same as the original 1.5L. A detailed analysis of the 3L is given in "Corrections & Additions" at PP. 53 – 55.

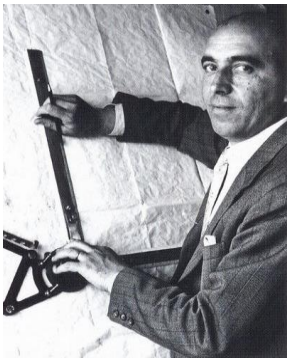
The PC 125s and after

When 1 stage supercharged in 1948 as the 125 Gran Premio Compressore (later retyped as 125F1) the 1.5L Ferrari had some success – in the temporary absence of the Alfa 158 team. Colombo redesigned the top end to double OHC and fitted 2 stage supercharging for the Italian GP in September 1949 (see "1st Pressure-Charged Era (1PC) Part 2" at Eg. 27). It won (with the lowest MPSP at 13.1 m/s of any CoY engine since 1908), but the following year could not match the returning 158s. But Colombo had left Ferrari to return to Alfa Romeo and there contributed to the further power development of his masterpiece. His former assistant, Aurelio Lampredi, took on the design of NA cars for the fight with the 158, beat them 3 times in 1951 and narrowly lost powering the Drivers' Championship at Barcelona in October of that year. With the writing very clearly on the wall, Alfa then retired from the Grand Prix arena. Colombo moved to Maserati. His second masterpiece, the 1.5L V12 Ferrari, as noted above, was the basis of very successful racing and road cars for many years (and the 3L GTO sells today for multiple millions of dollars!).

snaplap.com

Enzo Ferrari
in 1950

Gioachino Colombo



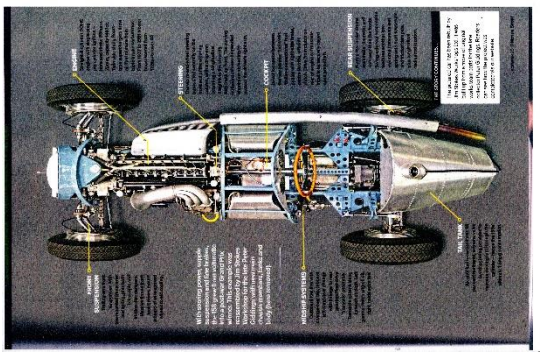
alchetron.com

Appendix A

Colombo's early 1937 proposal to design a mid-engined car

In "Enzo Ferrari" by R.Williams (Yellow Jersey Press 2001) Colombo is reported as saying (p.96) "*When I arrived in Modena I already had a definite plan in mind: to build a small car with a rear engine, a kind of miniature Auto Union. For some time I had been thinking about this project, and I'd been studying some possible solutions in my spare time*". However, having described this proposal to Ferrari the idea was not accepted; "*It's always been the ox that pulls the cart*". Colombo said "*It was clear that this was his joking way of concluding the discussion on good terms*".

That Colombo had been serious about the mid-engined idea is shown by his telling Griffith Borgeson (DASO 25 p. 115) about his IL8 engine that he had moved the camshaft and accessory drive to the front of the unit, instead of the traditional Petit-inspired Jano mid-crank scheme, so as to make the engine as short as possible.



A very-fine plan view of the 158 as actually built, in *Motor Sport* December 2019 (see LHS), enables the hypothetical mid-engined car to be sketched: the engine would have been about 80 cm further back in the 250 cm wheelbase (assuming the same base as the 158) so that the driver was a corresponding amount further forward. Fuel tanks would have to have been at the sides.

A table on P.5 compares the projected driving position with other cars.

Year	Car	Driver's C of G position, distance from front "axle" related to wheelbase. Approximate	Comment
1934-37	Auto Union A, B, C	36%	Oversteerer
Early 1937	Colombo's proposal	36% estimated	
1938	Auto Union D	48%	Understeerer
1938	Mercedes-Benz W154	82%	
1938	Alfa Romeo 158	84%	
1940	Alfa Romeo 512	34%	
1959	Cooper T51	53%.	Neutral

Colombo must have appreciated that the then-current Auto Union needed a driver with super-fast reaction times, like Stuck or Rosemeyer, to get good results. Nevertheless, it had been GP "Car-of-the-Year" in 1936. After Ferrari turned down his mid-engined scheme, he later would have seen that even Nuvolari in a one-off trial of the C-type Auto Union in the 1937 Swiss GP could only manage a practice lap nearly 7% slower than Rosemeyer and, in the race, handed over to the retired team leader when only 8th. When the Italian *maestro* was considering joining the German team in early 1938 he is credited by a biography (Nuvolari by G. Lurani Cassell 1959), after an early test of their initial 3L prototype, with persuading them to set the seat further back. After a shaky start by the team, he rewarded them with victories in the last two races of the year.

Front versus mid-engined in the '40s

These comments apply to the time before designers knew much about car balance by suspension.

- Auto Union

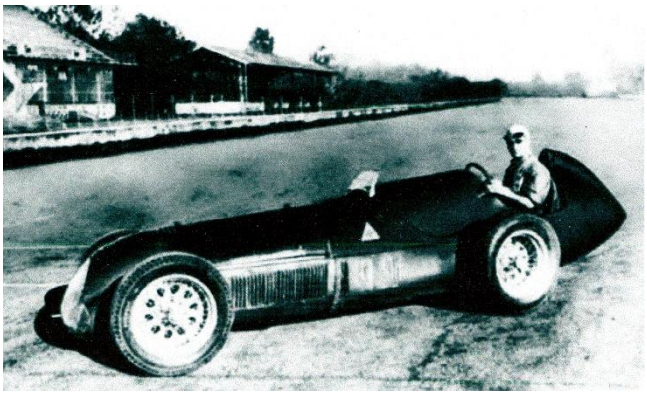
The Auto Union racing brand was firmly fixed in the public mind with the engine behind the driver and the team had been formed specifically to publicise the new 4-firm group but, in spite of that, the firm were contemplating a front-engined car for 1941 (DASO 30).

- Alfa Romeo

When Ricart in 1940 designed the Alfa Romeo 512 as a mid-engined car, one can imagine it confirmed Ferrari's poor opinion of that gentleman! The figures in the table seem to bear that out.

Consalvo Sanesi told Borgeson (DASO 25) that he found on test at Monza that the car was 2 seconds a lap slower than a 158 with 100 CV less power! Part of the problem may have been that the suspension stiffness was inadequate.

A *rear-seated* 158 experiment!



Motor 24 June 1967 had an article by Giuseppe Busso of the Alfa Romeo Experimental department describing how he had tried in 1952 the very-opposite of a forward-seated racing car – a *rear-seated machine!* This was a lash-up on a hack 159 (158 with de Dion rear suspension) at Monza (see picture at LHS). Sanesi was the driver and came in after 4 laps to complain about everything, especially the unshielded cockpit – the windscreen had not been moved - and was surprised to be told that he had already been only about 3% slower than the best lap by an up-rated 159M driven by Fangio in 1951! The figure for the driver location was

1952	Alfa Romeo 159 special	118%.

The experiment came to nothing, as the firm did not proceed with the 2.5L car for the 1954 formula for which it was intended. The author feels that the danger to the driver of a rear-end shunt would probably have ruled the location out anyway, either by the management or the racing authorities.

The Cooper Revolution

The table above gives the driver location data for the first of the two Coopers which, over 1959 and 1960 in Jack Brabham's hands, established the Mid-engined Revolution for Grand Prix cars. The difference from previous cars with that layout was, of course, that the Cooper cars had begun fortuitously with suspension balanced at front and rear. This is described in Notes 66 and 66B.

Even Enzo Ferrari had in 1960 to admit that the *ox* could *push his cart* – and very successfully in 1961! But he had in 1937 saved Gioachino Colombo, with the knowledge about suspension of the time, from committing a mistake*.

*Curiously, in England in 1935 Lord Austin for a completely different reason had stopped Murray Jamison from producing a new mid-engined 750 cc racing car. Probably also influenced by the Auto Union, Jamison had proposed that scheme to his boss. A mock-up was made. Austin would not have it because he thought that the driver – one of his young men – would be endangered by the forward seating position. So, he told Jamison to design a simple front-engined car, which became the famous Twin-Cam Seven (DASO 713).

References. Details of the DASOs quoted can be found in Appendix 3:- D22, D25, D30, D138, D713.

The mid-engined winners of the Drivers' and Constructors' Championships, 1959 & 1960.

worthpoint

Jack Brabham
1959
Cooper T51
Coventry Climax
NA FPF 2.5L.

Jack Brabham
1960
Cooper T53
Coventry Climax
NA FPF 2.5L

goodwood.com