INTER-ORGANIZATION LETTERS ONLY

CHEVROLET

TO	Mr. Maurice Olley	ADDRESS	Research & Development Section
FROM	Mr. Z. Arkus-Duntov	ADDRESS	Research & Development Section
SUBJECT	NOTES ON 1953 LE MANS RACE	DATE	June 25, 1953

With passage of time and the development of automobiles, the key note of these unique tests shifted.

In the early races, the winner was the man spending the least time on roadside repairs. But already in the first race (1923) the winning cars were streamlined. The key note in the following years, apart from reliability of basic components and accessories, was maximum speed on Mulsanne straight.

Subsequently, it was realized that the race can be won on Mulsanne straight, but lost on Mulsanne and Arnage corners and the cars began to be built with accent on top speed, brakes and acceleration.

Presently, I believe the key note should be high speed handling - the faster cars reaching presently the stage where over 2/3 of the circuit, the speed is the function of handling. The cars have the ability to accelerate to the very fast bends to the much higher speed than these bends can be taken.

The increase of speed through the bends itself raises the speed on approach and get away from the bend and therefore raises the overall speed level considerably.

As an illustration, last year J2X cars with 220-230 H.P., 3000 lb. starting weight and top speed at some 140-145 mph, were lapping in 5 minutes. This year with 250 H.P. in No. 5 and 2500-2600 lb. starting weight and top speed of 160 mph, the lap speed went down to only 4 minutes, 52 seconds. The cars were giving away on bends almost all what was made on superior top speed and acceleration.

For better understanding, a sketch of the circuit with speed distribution is attached.

The participants in this year's race were almost exclusively factory teams manned by crack drivers. The random notes on technical characteristics are as follows:

WINNING CARS

Jaguar - Disregarding the result of the 1952 race on which all Jaguars were out after two hours due to overheating, the high increase in average over their 1951 win is due to intermediate developments and excellent weather as compared to the rainy 1951 race. Two factors which are known to me may account for improved performance -

(1) Disc brakes, discussed elsewhere.
(2) Replacement of two S.U. carburetors with, essentially 6, Weber carburetors.

From my experience with S.U. carburetors, I know that unless the lower and middle end of the power curve is sacrificed, the vacuum of minimum 2 to 3 inches of mercury is necessary to keep the vacuum actuated gate open.

Going over to fixed venturi carburetor could increase the power by some 6 to 10 H.P. per 1" of mercury manifold pressure. Using one venturi per cylinder must result in further decrease of pressure drop, more even mixture composition and air distribution.

The total gain due to these changes could be assessed as 20 or 30 H.P. The extra H.P. and improvement on the brakes together with excellent weather throughout the race may well account for the high winning speed.

FASTER CARS

Faster cars on the course were Ferrari's, but higher fuel consumption forcing frequent pit stops was offsetting this advantage. Furthermore, they apparently imposed much higher driving effort and concentration. Up to Tom Cole's crash, Ascari's Ferrari was gaining on the leader but from this point on Ascari started to lose speed due to a slight emotional upset.

Cadillac Allard Cars - The redesigned chassis were faulty in design and execution. They were oversteerers for small roll angles. The reaction to steering was outrunning human reflexes.

On acceleration they reversed their characteristics to understeer and under heavy acceleration were not reacting to the steering wheel at all. On a 120 mph bend, they would run through the complete specter, diving toward the inside at the beginning of the bend and as the throttle is applied, would dart to the outside.

The car was difficult to control on smooth Mulsanne straight but still could be driven at maximum speed. On the remaining 2/3 of the circuit, the handling was a limiting factor and the cars which potentially could be the fastest had to be driven with restraint.

Since this behavior shed some light on the question of handling in general and on the characteristic of front swing axle in particular, this question will be a subject of a separate analysis and report.

The valuable part of this experience is that the same basic layout - the J2X type - was a perfect handling car. Therefore, the causes of transformation can be pinned down precisely.

ENGINES

Engine of Car No. 4 had a different camshaft providing some 30 H.P. plus as compared to Car No. 5. Otherwise, they were identical. In practice, both cars were losing water and then would boil. The engine of Car No. 4 without apparent reason disintegrated - one piston completely gone - upper part of tie connecting rod went through the block and connecting rod bearing was gone as well. What happens first is difficult to say.

The loss of water was brushed away as something due to the fault in the cooling system which was consequently somewhat modified. Car No. 4 driven by S. Allard led the first lap and was out of the race after 4 laps - insufficient bracing of rear end housing against the prop shaft torque resulted in housing being ripped out of the frame and cutting brake lines in the process.

Car No. 5 driven by myself ran satisfactorily for approximately one hour. Signals from the pit indicated that I was running near record speed. However, the fact that cars drew level or even passed me, which I knew were not capable of such speed, was irritating. The story was that the pit stop watches were some 20 seconds slow. The pit realized the error after a while but since the actual speed I was running was the speed they thought would win the race, they kept feeding me with wrong information.

After 20 laps, the water temperature soared and the car was brought to the pit, since no water can be taken on until elapse of 28 laps; after cooling time, the car was nursed for 8 laps at slow speed after which refueling was made.

My co-driver then took over and ran at somewhat slower speed for approximately 3 hours with temperature at 200°F. The car was then refueled. Two quarts of oil and some water were added.

I took over and on the 4th or 5th lap, the engine disintegrated on Mulsanne straight. Outwardly, the connecting rods could be seen but since steam and oil clouds were present during disintegration, the failure must have been of the same pattern as with the first engine on Car No. 4.

The engines are due to arrive here for examination, after which a somewhat clearer picture can be made. However, I do think that the practice of machining the cylinder heads to increase compression ratio reduces their strength to the extent of allowing breathing under load of explosion with consequent escape of gases into the cooling system and ensuing loss of water.

Furthermore, the oil consumption, with wet sump due to splashing, could be high enough that toward the end of driving spell (some 30-40 laps, 150-200 minutes, 260-340 miles) the oil level gets so low that on bends the oil pump is washed dry.

As my co-driver handed the car over, he mentioned pulsating oil pressure which seems to confirm my line of thought.

CARBURATION

The engines were equipped with two 4-barrel carburetors with ram air intake. The float level control was unsatisfactory - on sharp bends one group of barrels would run dry and another group of barrels would dump the fuel into the manifold. Coming of bends, the engine would run on 4 cylinders, more or less, stuttering for 1 to 3 seconds. Furthermore, the carburetors were not sufficiently adapted to ram intake.

It did not manifest itself on full throttle, continuous running, but every time the throttle would be closed and then reopened, a delay of a few seconds would ensue and then the power would come with a bang.

Summarizing the engine situation, I believe that engine-wise both cars were potentially the strongest contenders in the field but due to chassis shortcomings, the circuit speed could not be maintained with minimum safety required and they could not last due to the oversight of difference in operating conditions of a test cell or short sprint race and the conditions of the fast race of a long duration.

ENGINES - IN GENERAL

Every make in evidence was following their established practice with exception of Lancia which used supercharged power plants.

General trend amongst the Italians was toward increase of displacement. The continuous improvement in racing performance of large modified American stock engines was undoubtedly responsible for this development. However, the winner of the race was the best overall balanced design and not the most powerful car in evidence.

The characteristics of the engines used are well known and therefore we will dispense with their description.

CARBURATION

One venturi per cylinder increases in popularity. Ferrari, Jaguar, Aston Martin all have Italian Weber carburetors in this arrangement.

The popularity which Weber carburetor enjoys is based, in my opinion, not on the virtues of the carburetor but on the knowledge of carburation and engines in general by Weber engineering staff.

The majority of the cars employed controlled air intake - some utilizing the ram effect, some just supplying the air in general.

In the case of Bristol's, the ram intake prevented engines from running properly and upon advice they provided escape vents, after which the engines were running normally.

The ram intakes of the Allard are covered under the heading "Allard Cars".

BODIES

The bodies in evidence were almost exclusively all enveloping with attempts to provide free egress of air from the front fenders.

Bristol Aeroplane Company had aerodynamic coupes with stabilizing fins of elaborate outlines. The cars were slow everywhere. It was doubtful that they were even reaching 130 mph with 130 to 140 H.P. engines.

On the Mulsanne straight which is lined with alternating woods and open spaces, they did not appear any more stable than a plain enveloping bodies car and due to their low speed, looked somewhat ridiculous.

Both cars crashed at different times, both due to blow up of engines with ensuing oil fires. The exhaust lines being carried from the right hand side to the left hand side under the oil pan were on hand to provide illumination.

Fortunately, both drivers lived to tell the story that the damage to the scenery on the right and left sides of the road was due not to the loss of directional stability but to fight for survival in flame filled cockpits.

Alfa Romeo bodies were of normal shape and one can only guess the reasons why the "disco volantes" (flying saucer) bodies were not used after a year of development and publicity. "Disco volantes" were designed with the idea of reducing sensitivity to the cross wind.

As the picture indicates, they have a symmetrical elliptical cross section with long axis placed horizontally. I was unable to obtain positive information on their behavior. All cars retired (one positively with transmission trouble).

Aston Martin's body change, with curvaceous up kicked front and rear fenders, can be only explained as an attempt to provide guiding surfaces equivalent to fins. To promote directional stability with top speed at 140 to 145 mph, their worry seeems to be not well founded. One car crashed and the second abandoned.

Pegaso's always shown with most futuristic bodies were equipped with open bodies of conventional shape but one car crashed in practice injuring the driver and the second car was withdrawn. Last year also, the cars were withdrawn because they did not handle and did not "run on 8 cylinders". It is not possible to determine the causes of withdrawal this time, and this fact or short coming in handling are both equally likely causes.

BRAKES

With the exception of the winning Jaguars equipped with Dunlop spot disc brakes, all other cars were equipped with conventional brakes. All of the faster cars were using bi-metallic drums, some Al-fin bonded, some simply consisting of liners cast in aluminum or magnesium housings. The French Talbot had additional copper studs cast into the drum and running radially from iron lining outwards.

Lancia's had a very unorthodox inboard front brakes driven by universal shafts from the wheels, object - reduction of unsprung weight, the effect - who knows.

The drivers of the disc braked Jaguars were enthusiastic and according to information from one of the drivers, reduced the braking distance before the Mulsanne corner from approximately 500 to 250 yards. The distance of 500 yards was due to inferior brakes of last year's Jaguars (400 yards for last year's Allard). So the gain can be assessed as 150 yards or almost 40%.

The brakes were self-adjusting and did not lose effectiveness throughout the race. My observations of delayed application of the brakes dovetailed with the statement of the driver.

Their main virtue must be deemed the uniformity of performance. Absence of the fade with consequent confidence of the driver that he is going to stop and can, therefore without reducing the margin of safety delay the application of the brakes, increases the average speed considerably.

TRANSMISSIONS

All mechanical 4 and 5 speeds with exception of the Allard having 3 speed Cadillac mechanical transmission of which only 2 speeds were practical to use.

All Alfa Romeo cars retired with transmission trouble. Of one car I am positive, the others I do not know. (The official reason of my retirement was oil leak which was in a way true. The connecting rods do make such big holes while departing from the crankcase. The officially given reasons are sometimes misleading).

TIRES

Dunlop, Pirelli, Firestone, Continental and Englebert were in evidence. The tire consumption on this course is remarkably low and in case of larger cars, two complete sets are sufficient. (Winning Jaguars, to my knowledge, changed only two wheels).

In an attempt to improve handling of the Allard, a test with 30 lb/in^2 for 600 x 16 front tires and 45 lb/in^2 for 650 x 16 rear tires was made. The front tire had thrown the thread at approximately 150 mph. The inflation of 37 lb/in^2 in front was found adequate (last year's inflations - 45 front, 55 rear, 650 x 16 on all 4 wheels).

Incidentally, Dunlop feels that for speeds in excess of 110 to 120 mph, a 15" wheel is the minimum safe size admissible.

A set of tires by Pirelli with visibly aperiodical pattern was observed in the Ferrari pit. The explanation offered was that at high speed periodical pattern tends to induce wander of this particular car and this tire is supposed to be successful in preventing this occurrence.

(An attempt to have a technical chat with Dunlop manufacturing engineers repeatedly failed. Due to maintenance of open houses by accessory manufacturers, the engineering profession had opportunity to indicate their preference for more elaborate fluid than plain water).

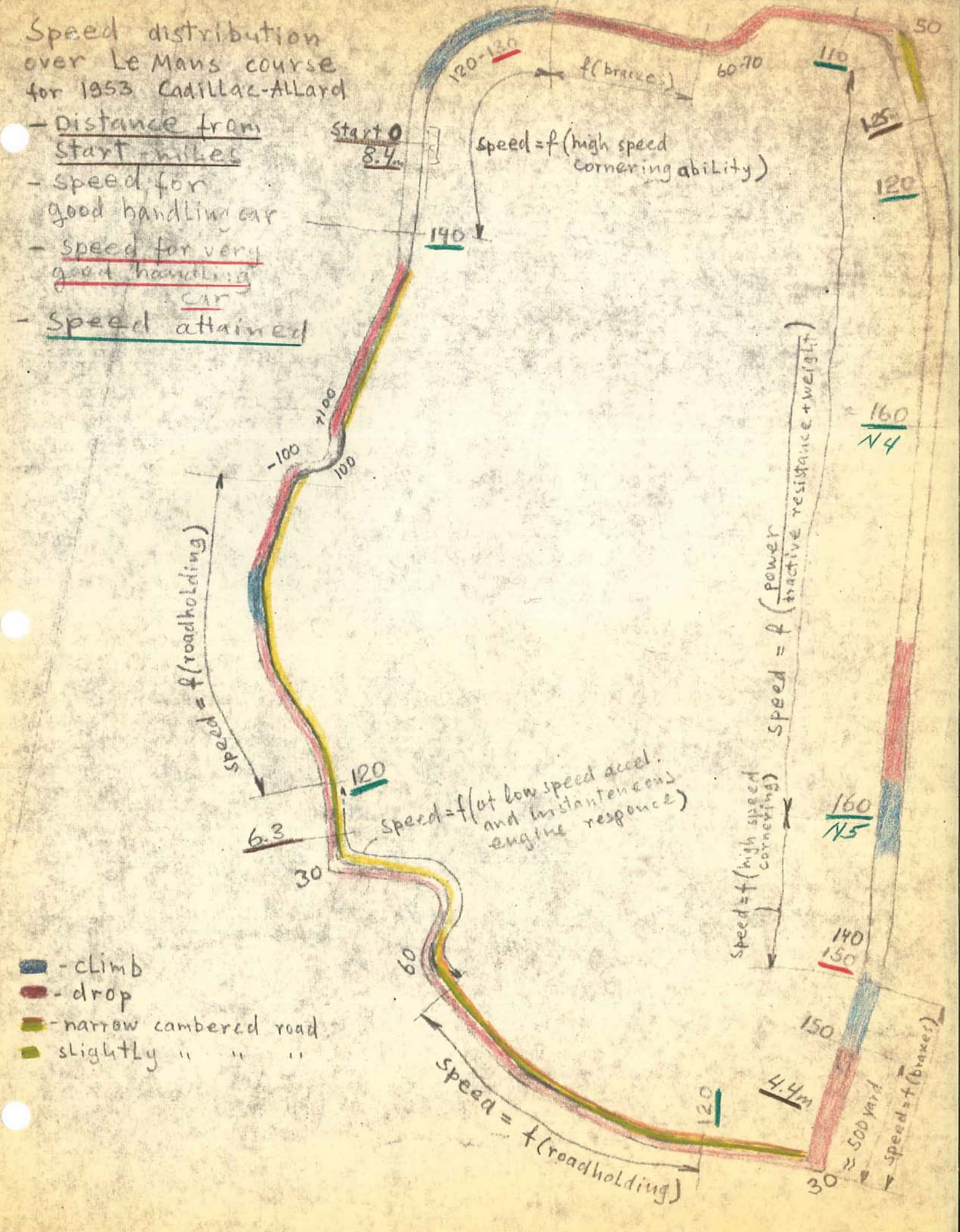
Serious attention is being paid to the tire cooling as evidenced in body shapes and directed air flow on rear tires by Alfa Romeo and Ferrari.

Details pertaining to this question are contained in my report of June 19, 1953.

Z. Arkus-Duntov

ZAD:hs

cc: Mr. E. N. Cole
Mr. M. S. Rosenberger
Mr. M. Rose

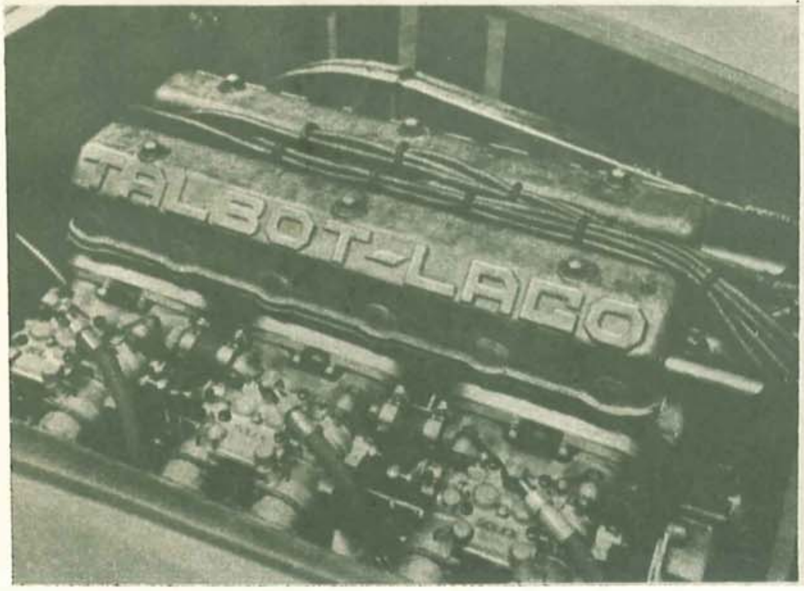

Speed distribution over Le Mans course for 1953 Cadillac-Allard
- Distance from start - miles
- speed for good handling car
- speed for very good handling car
- Speed attained
Start
8.4m
120-130
f(brakes)
60-70
110
50
135
120
Speed = f(high speed cornering ability)
140
160
N4
+100
-100
100
Speed = f(roadholding)
120
6.3
Speed = f(at low speed accel. and instantaneous engine responce)
30
Speed = f(power / tractive resistance + weight)
Speed = f(high speed cornering)
160
N5
140
150
60
150
4.4m
120
Speed = f(roadholding)
500 yds
30
Speed = f(brakes)
- climb
- drop
- narrow cambered road
slightly " " "

straight bevel gears and is carried on half-elliptic springs.

Except that the size has not been changed, the six-cylinder engine is an entirely new production. The cylinders

oil radiator.

The brake drums are in forged Duralumin with steel liners, having an internal diameter of 15¾ in. The back plates are fitted with air scoops and the application of the Ferodo-lined shoes is by the Lockheed hydraulic system; there are two mas-



Outwardly similar in appearance to their predecessors, the 4½-litre engines are entirely new. Light alloy cylinder blocks and detachable heads are used, and the valves are push rod operated from two camshafts.

conduit directing a certain amount of air to the front brake drums, and some to the driver's feet and the exhaust pipe, but the main discharge is into the rear-wheel housings for the cooling of the brakes and tyres.

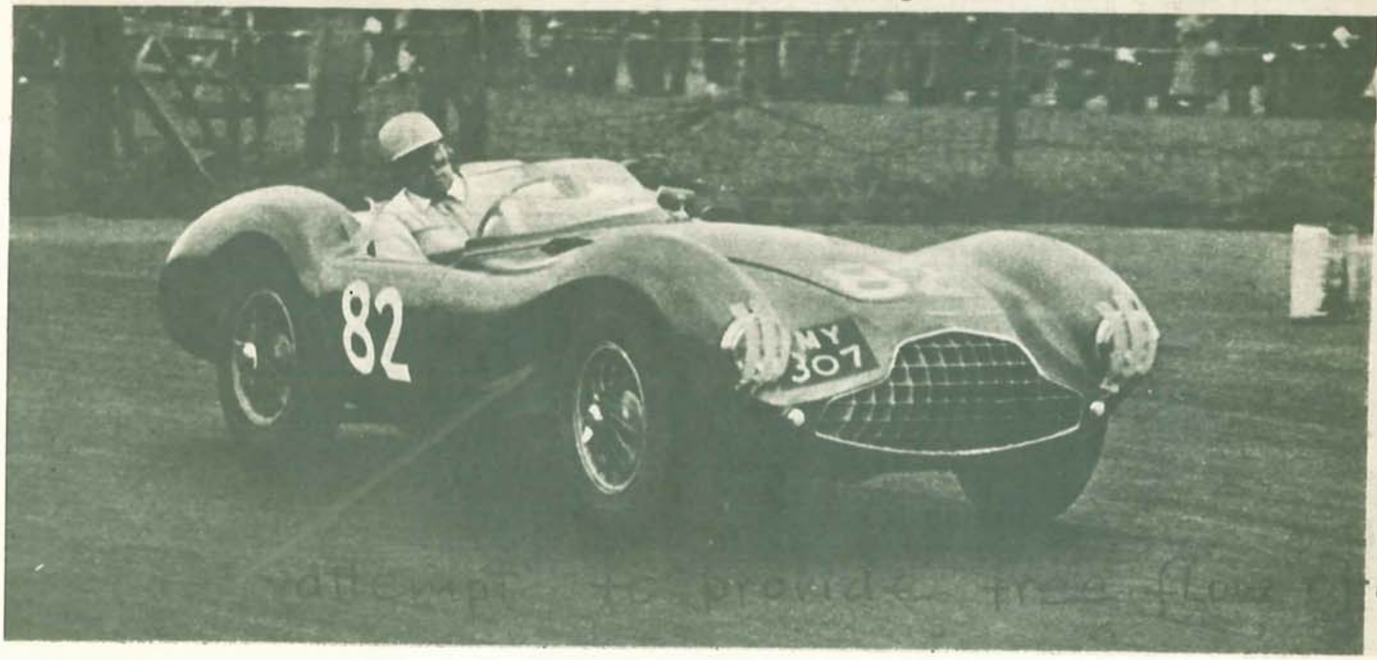
The fuel tank is mounted directly on the chassis, behind the driver, and has a hinge snap-down filler cap of practically 5in diameter. The oil filler is a similar but smaller type on the scuttle, just in front of the driver. A spare wheel is carried on the right-hand side of the chassis, but is completely enclosed in the flat-sided body, access to it being by the removal of a quickly detachable panel. The Wilson pre-selective gear lever is just below and to the right of the steering wheel, the movement being from top to bottom as the four ratios are engaged.

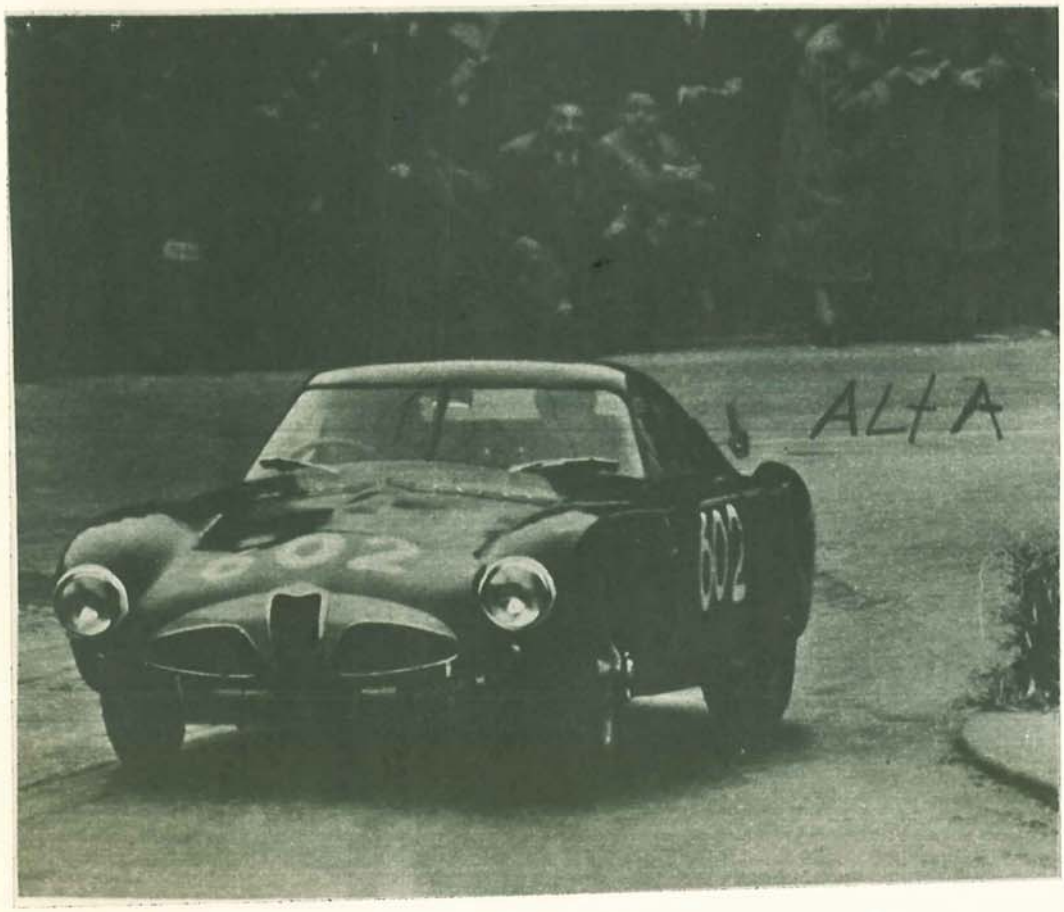
All the cars will be fitted with Dunlop 6.50 by 18in tyres on the centre lock wire wheels. The wheelbase is 8ft 2in, and the total dry weight is stated to be 20 cwt.

Single ventury per cylinder using soLex duaLs

The latest version of the DB3 Aston Martin has considerably more curved body lines; it is seen here making a successful debut at Charterhall on Whit Saturday in the hands of Reg Parnell.

P.T.O.

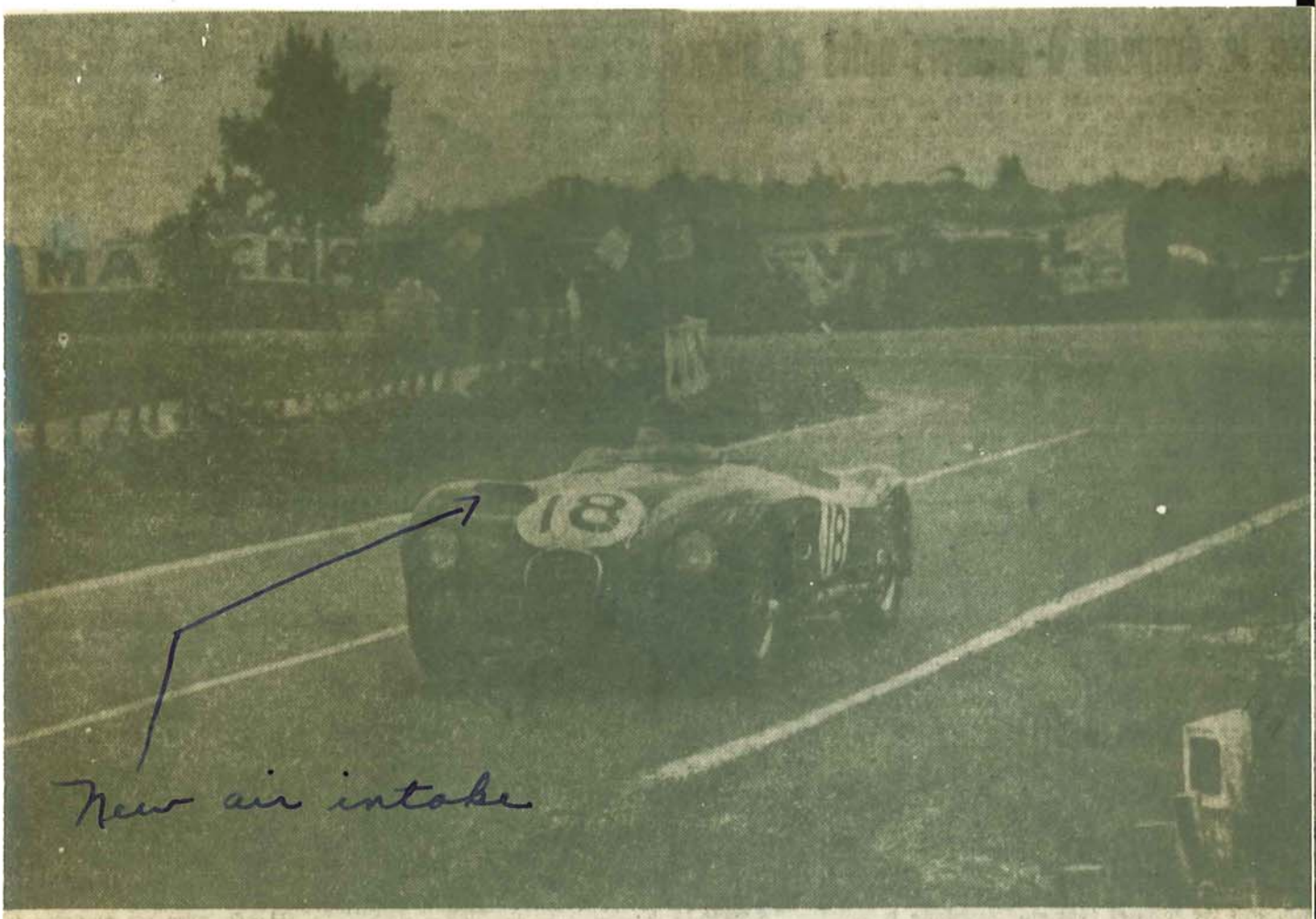




ASCARI VAINCU A ACCOMPLI UN EXPLOIT

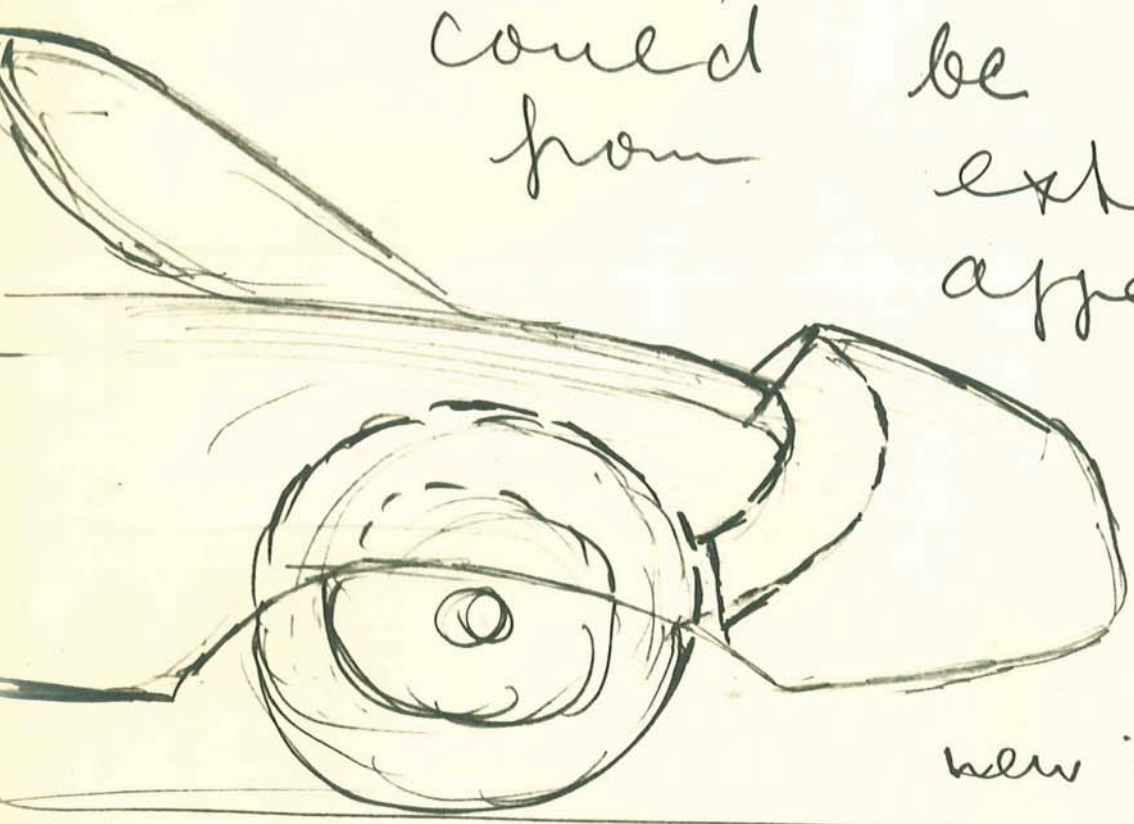
LE MANS. — Longtemps l'adversaire le plus dangereux de la Jaguar victorieuse, le champion du monde Ascari fut lâché par la mécanique. Mais sa Ferrari lui donna l'admirable consolation de battre le record du Tour à la moyenne extraordinaire de 181 km 642 !

Ferrari



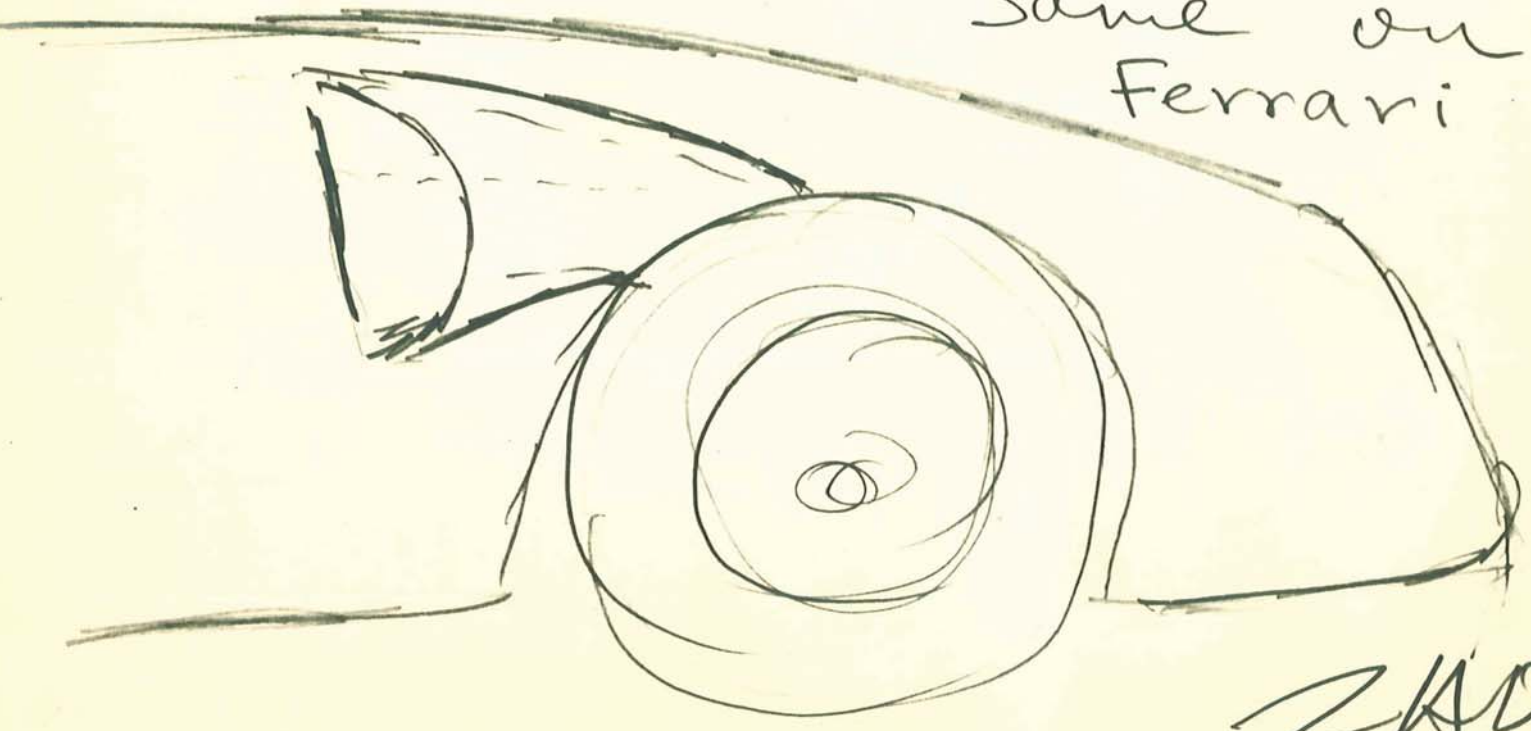
La « Jaguar » victorieuse vient de prendre le virage de Mulsane. (Photo de notre envoyé spécial Louis Couvert.)

Alfa Romeo Air ducting to rear tires, as it could be guessed from external appearance



new idea for stylists?

Same on Ferrari



ZAD.

FRENCH TALBOT BRAKES