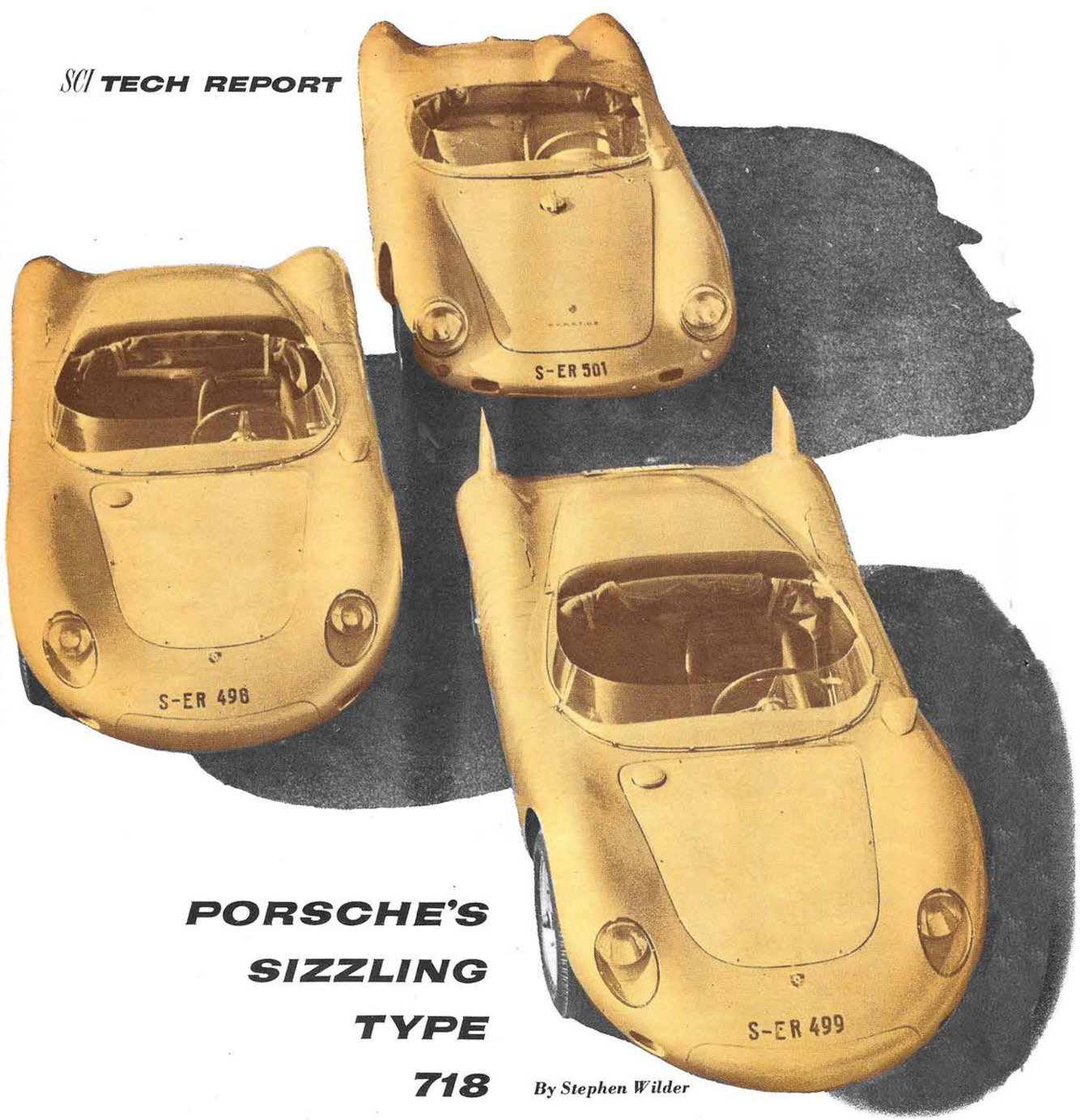


PORSCHE'S SIZZLING TYPE 718

By Stephen Wilder

"NOW LOOK, how can a half-size sports car be running second in the World's Championship? Why, it's nothing but an overgrown VW Special." Such remarks might get any bench racing session off to a good start, so let's look into it.

Obvious as its lineage is, the latest Type 718 Spyder is too highly developed by far to be referred to so casually in anything but jest. As to the question, well, part of the answer is Good Drivers, but it still takes good cars to get the good drivers. Another, to be sure, is that points earned by a car through stubborn reliability are just as good as those won by dazzling performance.

Analyzing the Spyder inevitably involves one in its design history. A couple of worthwhile engineering truths are strongly pointed up, too. For a basically novel concept to triumph against more conventional opponents, details and components of equal novelty must be worked out — successfully. The other is that compromises are as unavoidable in auto design as elsewhere.

Even the first Porsche is part of the Spyder's history. Back in 1948, its hopped-up Volkswagen engine was located in front of the gearbox, which moved the center of gravity forward at the expense of accessibility and usuable space. Except for its tubular frame and light alloy body, the rest was all Volkswagen, suspension, brakes, wheels and so forth.

Thus, from the very beginning, Porsches have all been linked to the basic VW layout; rear engine and gearbox, suspension at the front by trailing arms and transverse torsion bars and at the rear by swing axles.

Let's analyze this a bit. When the engine lies between wheels that don't steer, its width is no longer so important. There goes *the* big objection to the flat or opposed engine layout. As well, a much lower center of gravity is obtained. Incidentally, the Germans call them "boxer" engines as the plan view of the pistons in motion recalls the fists of sparring partners busily swapping punches.

With the gearbox bolted directly to the engine, it is more compact to have the rear axles in between the two. The final drive gears and the differential may then be installed in the same gearbox casing for lightness. The gearbox proper *must* be all-indirect with the torque path turning through 180°. One advantage is that any gear ratio may be altered individually. Disadvantages are that it is not easy to fit any sort of quick-change device and, though less significant, power losses will be suffered in all speeds, even top. But as a bonus, it's actually hard to avoid independent rear suspension with this arrangement. Swing axles are one of the simplest means of achieving it and their recent development leaves little to be desired in stability and control.

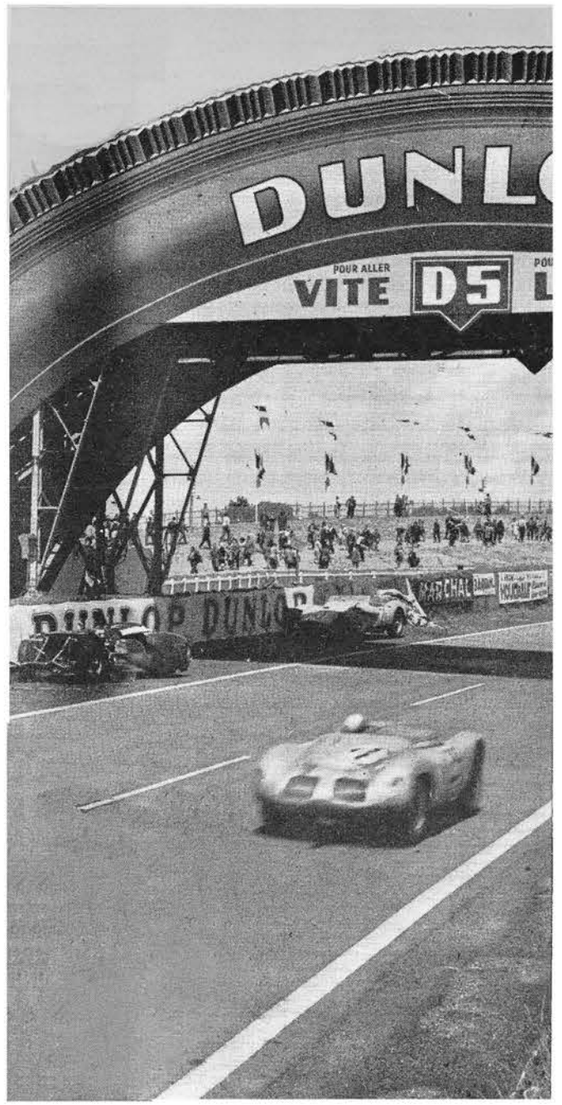
At the front, complete freedom of space allows the use of transverse torsion bars with paired trailing arms, but once these are chosen, a wide frame is called for. This is all right, since sports cars are quite wide at the cockpit and anyway, the flat four engine at the back is pretty wide itself. With such a wide frame, there's not much point in building a GP car unless you're going to go fast enough to need a streamlined body. This, to get a bit ahead of ourselves, is just where they were at Rheims this year. (First in the Formula 2 race.)

Now, given this very unusual layout with its myriad of novelties; once begun, it would have been impossible to turn the car towards a more normal configuration even if they'd wanted to. Not to be discounted with this firm or any other is that though the Racing Department races for the sheer love of it, Sales encourages them (when they're successful) for the advertising value to be had. The Engineering Department pitches in partly for the technical exercise but mainly for the useful lessons to be learned. Useful on the production line, that is.

One might venture to say that with all this VW background, "The breed improves racing", but the more normal statement is true too, as Porsche's road cars are continually showing up with some new device which cut its teeth on the Spyder.

Especially praisworthy is that so much has been accomplished by Porsche despite their starting off on a completely different tack. It's not that they've found a new miraculous way to build cars better than everyone else's, for the Spyder does have its limitations. For one thing, the biggest they've ever run the engine is 1587½ cc and this is a long way from the FIA's limit of 3000 for Appendix C Sports Cars. And it takes a heap of rectangular Deutschmarks to beat that many centimeters. If they should feel it necessary to build such a big engine (big? — the size of a Studebaker six?), the large increase in weight would make them pause before they'd pop it into the rear of a stretched out Spyder. When you change one item so drastically in a well rounded package, you will have to change a lot of others if the package is to stay round.

The resemblance of the very first Porsche to the Spyder layout has already been mentioned. The next "pseudo-Spyders" were the Glöckler-Porsches. One of them, developing 85 bhp on alcohol, set three 1500 cc International records in 1951 at Monthlery before coming to the States in the hands of Max Hoffman. Though carrying four-pin knock-off disc wheels of BMW 328 pattern, it too had a tubular frame and an aluminum body and the engine was in front of the gearbox.



Opposite page, two Type 718s, with and without fins; behind them, an earlier RS Spyder similar to those seen in USA racing, Above, the Behra-Hermann 718, finless, speeds past less fortunate cars under the Dunlop Bridge at this year's Le Mans.

PORSCHE Type 718 Spyder

SPECIFICATIONS

Type	Air-cooled, flat four
Valve Operation	Shaft-driven, four overhead cams
Bore & Stroke	3.45 x 2.60 in (87½ x 66 mm)
Stroke/Bore Ratio	.75/1
Displacement	97 cu in (1587½cc)
Compression Ratio	9.8/1
Carburetion by	Two Weber IDM twin-choke down-drafts
Max. Power	150 bhp (DIN) @ 7200 rpm
Max. Torque	117 lbs-ft @ 5800 rpm

DRIVE TRAIN:

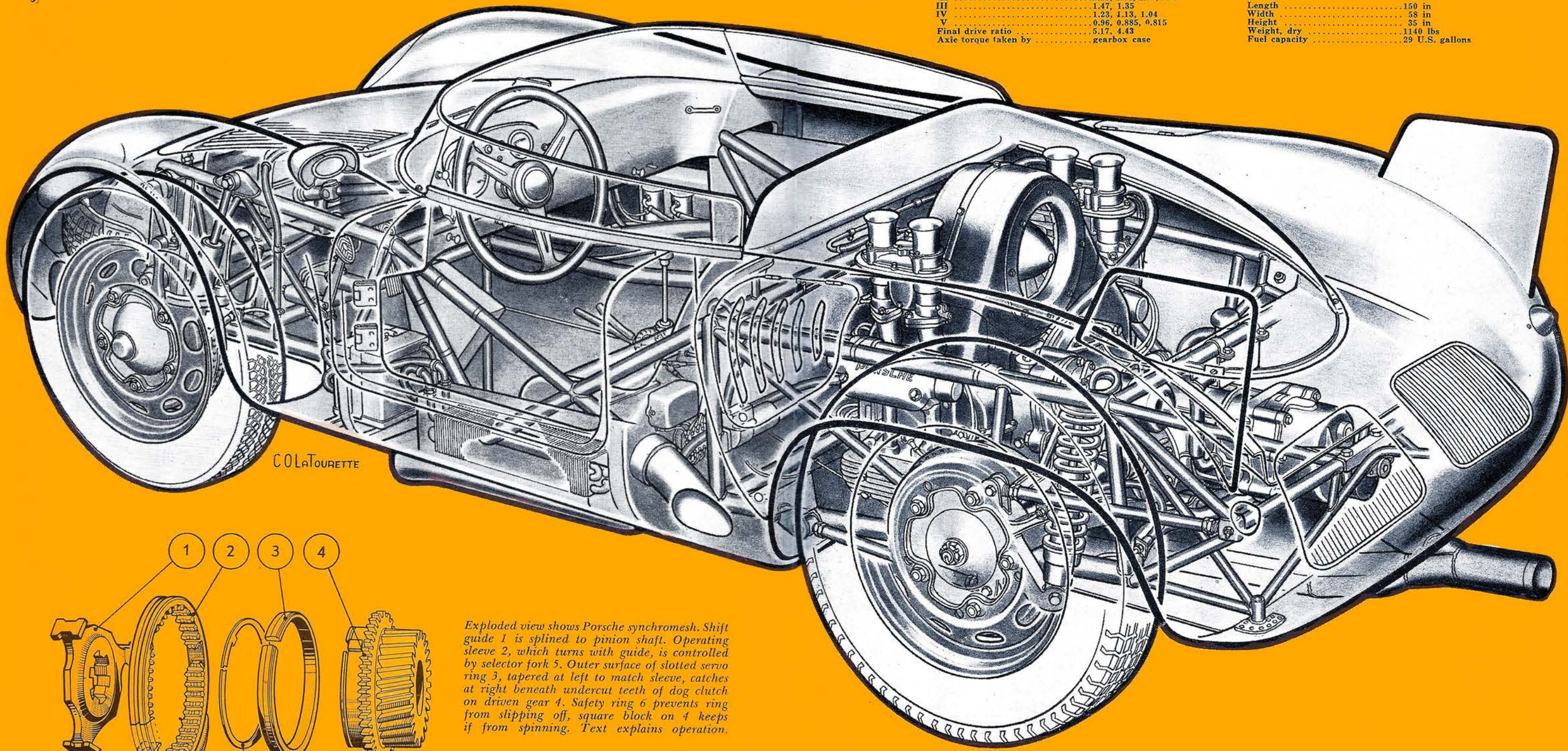
Clutch	Single plate, dry disc
Transmission ratios available	
I	3.09
II	2.13, 1.94, 1.76, 1.61
III	1.47, 1.35
IV	1.23, 1.13, 1.04
V	0.96, 0.885, 0.815
Final drive ratio	5.17, 4.43
Axle torque taken by	gearbox case

CHASSIS:

Space frame of small diameter tubes	
Wheelbase	83 in
Tread, front and rear	51, 49 in
Front suspension	Widely spaced trailing arms, transverse torsion bars
Rear suspension	Low pivot swing axle, fore and aft Watts linkage, coil springs
Shock absorbers	Fichtel & Sachs telescopic
Steering type	ZF worm and roller, steering damper
Turning diameter	36 ft
Brakes	2LS front, 1LS rear
Brake drum diameter	11 in
Tire size	5.25x16 (5.00x16 optional at front)
Rim size	3.50x16

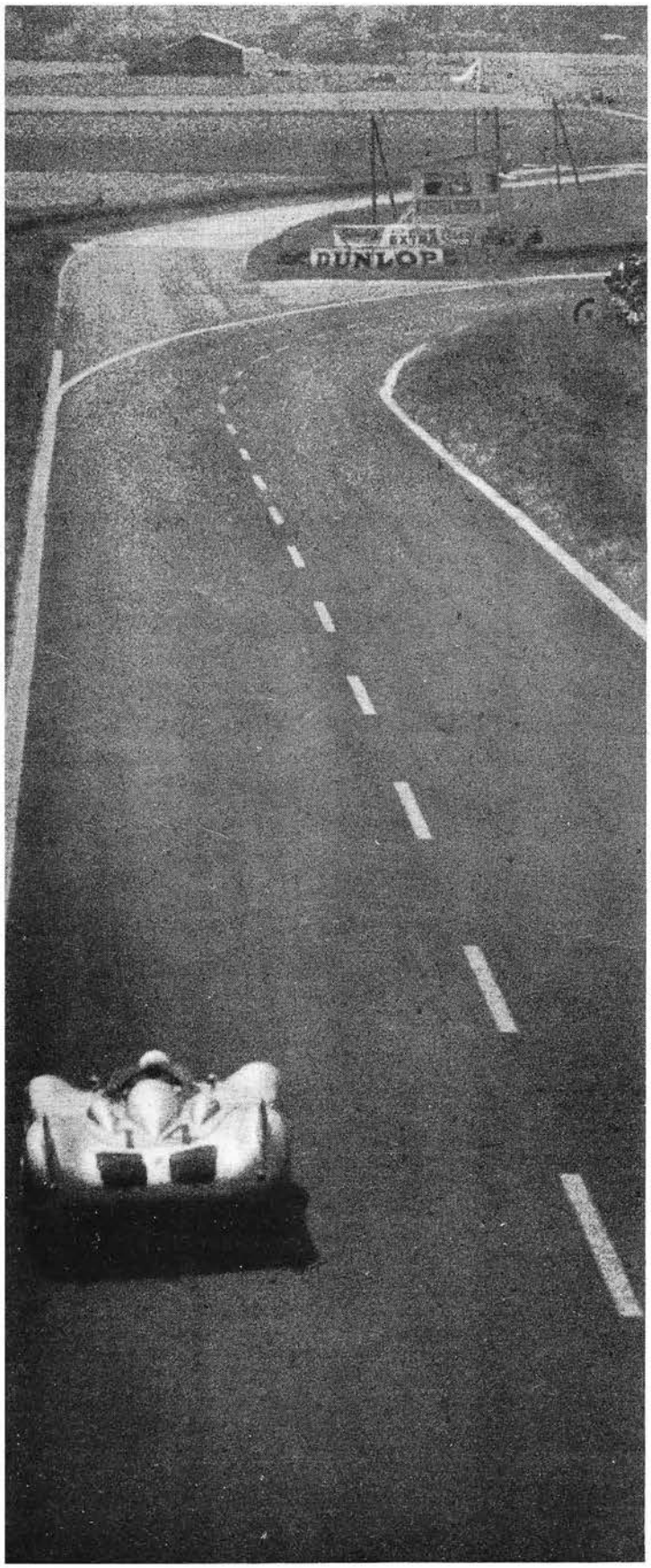
GENERAL:

Length	150 in
Width	58 in
Height	35 in
Weight, dry	1140 lbs
Fuel capacity	29 U.S. gallons



Exploded view shows Porsche synchromesh. Shift guide 1 is splined to pinion shaft. Operating sleeve 2, which turns with guide, is controlled by selector fork 5. Outer surface of slotted servo ring 3, tapered at left to match sleeve, catches at right beneath undercut teeth of dog clutch on driven gear 4. Safety ring 6 prevents ring from slipping off, square block on 4 keeps if from spinning. Text explains operation.

Porsche's first real race car, the modified 718's single seat, narrow headrest reduce frontal area for even better top speed.



Encouraged by Glöckler's success, but aware of his limited resources yet increasing competition, the factory built their first 550 Spyder in the spring of 1953. Work also commenced on a new flat-four air-cooled engine, to have two overhead camshafts per bank, but this wasn't ready until late summer. As it was, the Spyders were outstandingly successful with just the pushrod engines, winning several firsts and seconds that summer . . . Eifelrennen (Nürburgring), Le Mans, Avus, Nürburgring again and finally, the Freiburg-Schauinsland hill climb. The four cam engine first saw competition at this hill climb and, all too typically, finished third to the pushrod Spyder's first.

At first on the 550, as before, when the engine and gearbox were swapped around, the rear torsion bars were moved behind the axle line, too. But with longer flexible trailing arms (23.7 inches instead of 16.9), the torsion arms returned in midsummer to the more sensible location which creates toe-in on bounce and rebound rather than toe-out. Shock absorber geometry at the rear, none too satisfactory even on the VW, underwent several alterations, too. Eventually such a modication showed up as well on the A version of the Type 356.

In entering prototypes at LeMans, manufacturers once had to claim that these were the precursors of actual production models. Honoring this pledge, the Porsche works put the 550 Spyder on the market for a price (ex Stuttgart) of under $7000. At least 100 were sold, much to the discomfiture of the SCCA, but in truth, only a few were equipped or seriously intended for actual road use. Shortly after the supply was exhausted (no kidding, the factory was losing money on them), the works team appeared with a newer Spyder.

The RS (for Rennsport) differs in many details from the 550, but it still takes a careful look to tell them apart out on the track. A super-low starting gear was added on the tail of the gearbox, but the biggest step forward was in the weight saving and stability departments. A space frame replaced the simple ladder-like one and to lighten the body, the flip-top tail section was abandoned. Instead, two large access panels, very aircraft-like, permit changing plugs or carb jets but little else.

To improve stability through turns, the roll center was dropped by using low pivot swing axles. The drive shafts were splined to give sliding freedom. The spare tire was moved from above the gearbox — another detail from Porsche #1 — to the front end. At first strictly not-for-sale, these too trickled over to the States as soon as the works had something better underway: the Type 718.

But having come so far, making something better was no easy job and a lot of experimenting has been going on. Testing of the Type 718 went on during the entire '57 racing season and most of '58's. Early versions were known as the RS2 and then the RSK, the K indicating the angle of the upper front torsion bars. These allowed wider spacing between the trailing arms and at first ball joints were used. These have since disappeared. Known informally as the "Mickey Mouse" car, it was anything but stable at high speeds, von Frankenburg's crash at Avus and Behra's eight full spins on Mulsanne Straight (despite tail fins) at Le Mans being rather spectacular proof of it.

But this year's sweep of third, fourth and fifth overall at Le Mans indicate that earlier difficulties have been solved, so it is fitting to give a technical rundown on the current Type 718.

At Sebring this year, it was announced that coil springs were being used at the rear instead of torsion bars. A sharp break with Tradition (and the Sales Dept's point of view), it eliminated the heavy cross tube containing the torsion bars. The outer end of the low pivot swing axle is located by a fore and aft Watts linkage (see Technotes for August and this month). The sliding spline on the axle shaft itself is gone in favor of a spherical pot-joint at the inner end, a variation on the sliding U-joint used on the VW.

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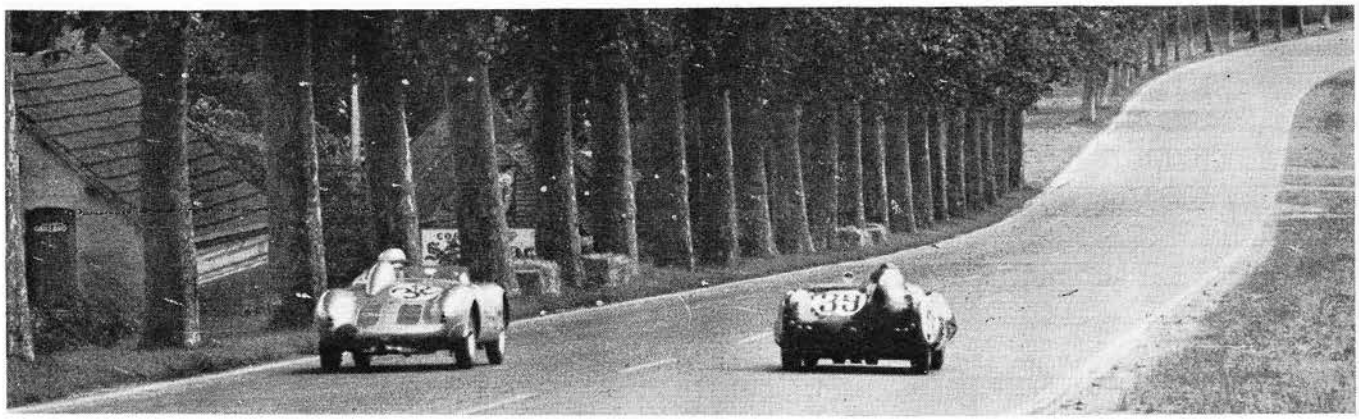
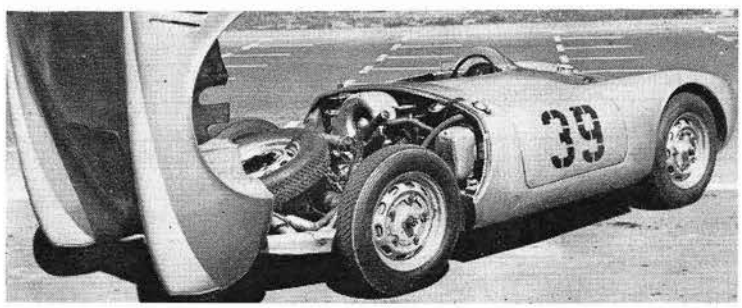
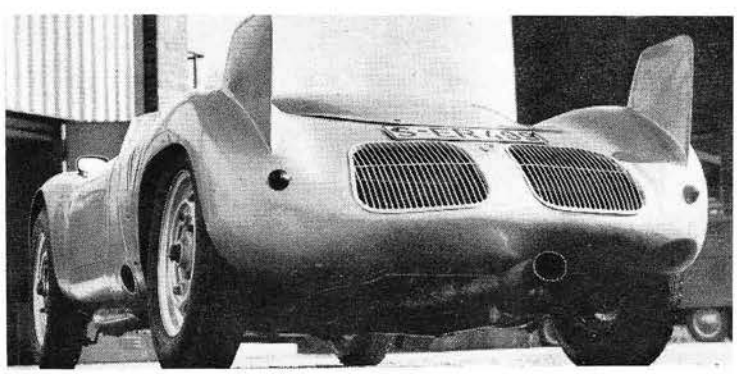
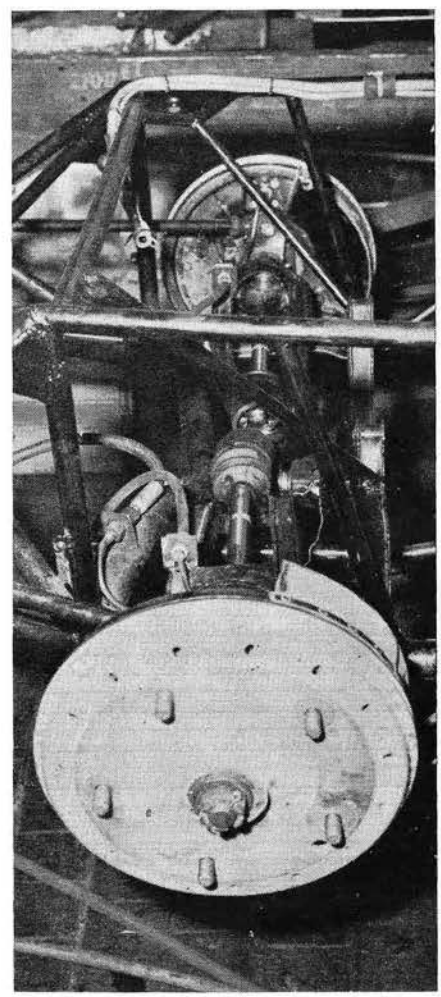
Photos by Jesse Alexander and Julius Weitmann



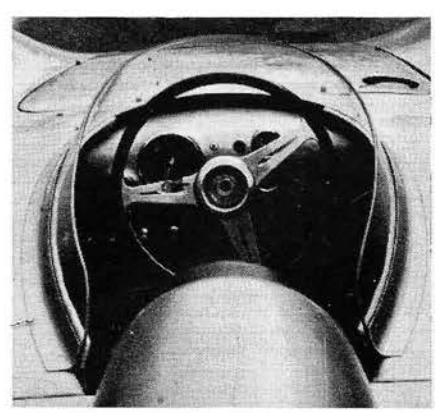
The last step before the 718, the RS still had torsion bars at the rear. Here de Beaufort-Linge's RS overtakes an 1100 Lotus







Above, top, the 550 featured a flip-top tail section long before Marlboros did. Middle, in a similar 550, Racing Manager Hüschke von Hanstein shows himself to be no pit-bound strategist. Below, the value of fins on 718 is disputed by team drivers. Some like them, some don't. Aesthetically? Hmmm. Perhaps someone's kidding Detroit. Right, low pivot swing axle requires two U-joints per axle shaft. Inner one slides in and out, like similar joint on Volkswagen.



With central seat and altered engine cover, the Barth-Frere Le Mans car (1498 cc) became Behra's Formula 2 mount at Rheims. He won very handily.

Porsche

(Continued from page 37)

The gearbox uses the same barrel case featured on the production cars since late '56, the additional fifth gear being carried in a separate box at the end. Within the gearbox proper, the four ratios all use the famous Porsche "Servo-ring" synchromesh invented by Leopold Schmid. Though it can be "beat" in the automotive sense, in everyday language it can't – provided the driver makes an effort to get engine revs *somewhere* in the right neighborhood. Key to the ring's function is a gap which lets it be preloaded. Compressed slightly during assembly, it catches under a lip on the synchronizing dog clutch. Before the shifting fork can move the operating sleeve completely into engagement, the tapered inner surface of the sleeve must ride up on the similarly tapered outer surface of the servo-ring. As the pre-load is taken up, the frictional forces are sufficiently high to bring the servo-ring and the operating sleeve to the same speed.

Brakes are bonded aluminum alloy with steel liners and very fat transverse fins. Though extremely wide and capable looking, these seem to be a weak point, as lengthy pit stops at both Sebring and Le Mans have seen front drums being pulled. Linings by Energit are a compound of steel wool and butyl rubber!

One of the reasons stopping is such a problem is the splendid aerodynamics of the 718. The 10% reduction in frontal area from the RS to the Type 718 and the 5% improvement in penetration have been mentioned before in these pages. In addition, Porsche learned a lesson from EMW/AWE and now they, too, prepare the bodies as if for Bonneville runs.

The frame is some 68 pounds lighter than before. Made up entirely now of small diameter tubes, the greatest saving comes in the complete abandonment of the rear torsion bars and their encircling tube. The upper longerons are shoulder height, giving ample depth. At the cockpit sides where doors are required, X-bracing fills the necessary gap. At the rear, carefully shaped cross members cradle the engine and gearbox, while at the front corners, tubes are omitted in favor of stamped uprights which carry the front torsion bar mounts. It's an interesting reminder that a frame's only purpose is to tie all the *working* components together in a rigid fashion. And the simpler and lighter it can be, the better.

The front suspension is again by twin transverse torsion bars and paired trailing arms. The vertical separation is about 50% greater than on a VW, which should reduce braking loads on the trailing arms appreciably. The upper torsion bar tube is noticeably shorter than the lower one, but it's no longer kinked in the middle. The hydraulic shock absorbers by Fichtel and Sachs are fastened to the bottom trailing arm.

A drawback to the twin trailing arm layout is the impossibility of arranging steering linkage that does not cause toe-out on bounce and rebound (except with the heavy, complex Dubonnet system). This toe-out is no more welcome at the front than it was at the rear on the first 550, but it's harder to avoid. The divided track rods are unequal, which adds to the confusion. To prevent wheel shimmy, a small steering damper (miniature shock absorbers) is connected to the Pitman arm.

Placed underneath the lower torsion bar, the spare tire projects well forward, the body's rounded nose just curving out to fit. Above, the surface-type oil cooler has been built into what for convenience's sake is called the trunk lid. Actually, the space below it is completely filled by the gas tank. A supplementary oil cooler lies in an air duct along the cockpit floor; both are controlled by a thermostat regulator. An oil tank of about 2½ gallons is mounted in the engine compartment just behind the "passenger's" seat.

Dr. Fuhrmann's engine design features four camshafts which operate through light fingers to reduce side thrust on the large valves. The latter lie at about 90° to one another; so do the spark plugs, though they are offset from each other as well. The cam covers, the paired cylinder heads, and the individual pistons and cylinders are all aluminum. So is the crankcase. It splits on its vertical centerline to accept the built-up Hirth roller bearing crankshaft and a dummy camshaft. The latter drives the oil pump plus four camshafts and four intermediate shafts. All nine shafts connected by bevel gears. No doubt the adjustment of valve timing is not a casual job. Like the Porsche Super, the cylinder walls are chrome-plated and knurled. The artificial irregularities trap oil on the walls, while the chromium provides hardness the aluminum lacks.

When first announced, the Spyder engine released 110 bhp at 7000 rpm. Now the same size engine is poking out 140. With an extra 100 cc's, another ten horsepower is realized. These figures are all DIN and can be maintained for up to five minutes at a time. Over-revving is not easily catastrophic, 8500 having been seen on the tell-tale of cars which subsequently raced and lasted.

Dual ignition in the European sense is used – two plugs per cylinder and two separate distributors. The latter were originally mounted on the ends of the intake (top) cams, but now a bracket next to the end of the crank shaft holds them both in a V position. Carburetion is through two Weber IDM twin-choke down-drafts. No more has been heard of fuel injection since last year.

Engine cooling is of course by air. A belt-driven centrifugal fan of considerable aerodynamic quality does the job. Porsche engineers say it take only eight or nine horsepower to run it. Unsatisfied with even this efficient figure, they have been working since 1953 with a method of cooling which should reduce it to zero! This is not a joke, nor is it a variation on perpetual motion. The exhaust gas of an engine contains plenty of energy, you have only to hold your hand behind the exhaust pipe at full throttle to dis-

Porsche

cover that. Why not use some of this wasted power instead of taking the hard-earned crankshaft power to blow the cooling air through? Compounding the engine, using an exhaust-driven turbine to run a compressor is a bit too complicated on so small an engine.

But it's on the right track. Patented over fifty years ago, Jet Cooling or perhaps more accurately, the Stream Pump provides the answer. Squirt a garden hose into a shallow puddle and what happens? The water already in the puddle is carried along by the fast moving stream. When this phenomonen is arranged inside a suitable boundaries, the efficiency is startling. Under certain circumstances, one pound of exhaust air can be made to carry along as many as fifteen pounds of fresh cooling air, an ample amount for even the hottest engine.

The drawback? Noise. Think how big a muffler would be required to handle sixteen Spyders at once! Though their engineers have been working on this phase of the problem too, there is a long way yet to go. So far they're said to be too embarassed to run it, even though it's a *racing* sports car.

There was a central seater Formula Two Spyder at Rheims this year. Are they ready to leap into Grand Prix racing? They already have the car, the drivers, and even the noise.

Stephen Wilder

Rallies

(Continued from page 43)

this country . . . and it was around 1950 that the rally began to be something not pertaining to politics. But naturally enough, with traffic conditions and traffic laws as found in the United States, our rallies took shape along the English lines, as opposed to the all-out continental lines. And as certain of the citizenry, not to mention the gendarmerie, failed to be *en rapport* with "those funny little furrin cars" tearing around the back roads, even more stringent time brackets were set up and all specified average speeds were well below posted legal limits.

Meanwhile, rallies were being organized in such far-off places as South Africa and Australia. With no speed-limit problems (the roads themselves took care of that) these events were patterned along the continental European endurance lines . . . and even more so. South African big game provided added thrills to bogged-down Johannesburg enthusiasts, while it was considered par for the course by down-under rallyists to have several cars lose personal bouts with kangeroos in the " 'Round Australia" run. With natural hazards such as these, plus the unbelievably rugged road conditions — from mountain passes to long stretches of desert, from tropical torrents to dust-choked dry river beds — there was never a reason for stating a minimum time to be taken, it was always a fight for all concerned to get to the finish line with

(Continued on page 58)