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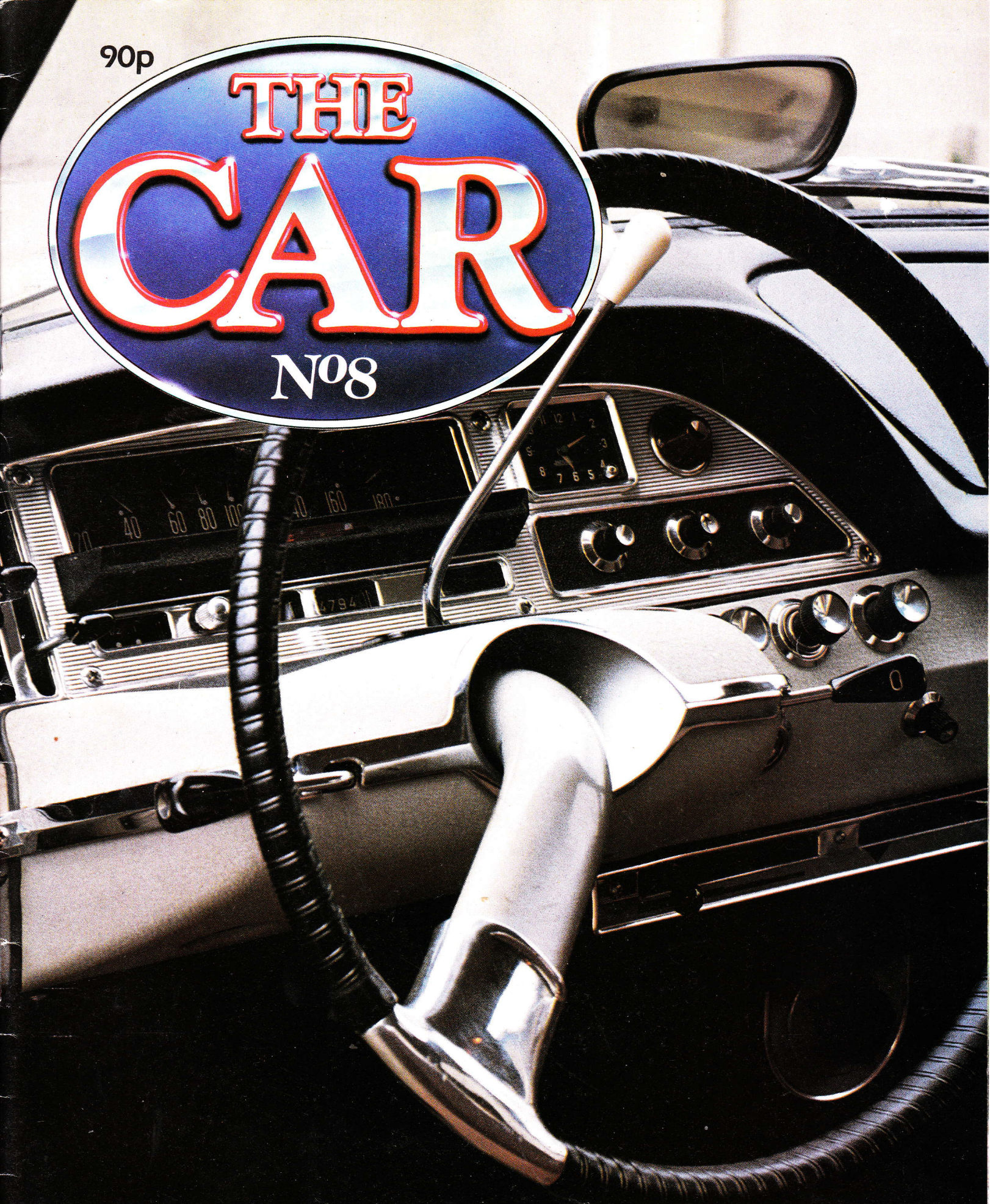
THE CAR

Nº8



ALL THE WORLD'S GREATEST CARS WEEK BY WEEK

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CITROËN DS

When the DS appeared in 1955 the world was more used to upright old fashioned cars like the first Ford Zodiac than the avant garde Citroën which introduced a new standard for the everyday saloon

IN THE LATE 1930s when work on the 2CV was safely underway, Pierre Boulanger, the manager Michelin installed at Citroën, set about his plans for a large volume-production saloon of extremely advanced design. Goodness knows that André Citroën's 1934 car, promptly enshrined in the language as *le Traction*, set remarkable new standards for its time; but technology was running riot, thanks to furious developments in the aviation industry, and Boulanger saw that much of it could be exploited in a concept to which the *Traction* logically led.

There can have been few people able to imagine the transcendent wonders being embodied in the new Citroën. Close associates of Paul Mages might have some knowledge of the engine-powered high-pressure hydraulics whereby the new car would be suspended, levelled, steered, braked, and semi-automated in its transmission, but not many would also be aware what magically authoritative shapes were being conjured for the bodywork by Faliminio Bertoni. Even fewer knew about the engines schemed for the DS by Walter Becchia. The former Fiat and Sunbeam designer was building two flat sixes, one water- and one air cooled.

Alas, both were shelved. The DS was going to cost an awesome amount to put into production anyway, without developing and tooling up for new engines, however great their promise. Its power would have to come from a merely modified version of that mildly agricultural perpendicular four-cylinder thing that had sufficed so long in the *Traction*.

It is unlikely that this compromise influenced the bonnet contours planned by M Bertoni for the awesome new body. Stylistically it was one of the most refreshingly non-derivative designs ever to go into production; in practical terms it displayed some most imaginatively useful features; in technology it employed new materials in new ways; and aerodynamically it was one of the best production saloons in the world.

From the very beginnings of the firm, Citroën had been the most advanced practitioners of mass-production technology outside the USA. André Citroën himself had been in this a disciple of Henry Ford, and had himself struck up a fruitful business liaison with Edward G. Budd, the pioneer of pressed steel bodybuilding whose firm had prepared the way for the stiff and sturdy steel hull of the *Traction*. All this know-how went into the DS body, but now it was more advanced than ever: the basis of the structure became a floor pan allied with a skeletal superstructure to which the most vulnerable panels could be bolted. This allowed fast and cheap repairs to accidental damage, but the idea was taken further: the roof was made detachable too. Moreover it was made of glassfibre-reinforced plastics, not of steel, and this material, then still very new and strange, was left unpigmented so that the roof should be translucent. After all, it was reasoned, since glassfibre was acoustically and chemically almost inert, what point was there in plastering insulants and linings onto its inner surface or paint onto its outer? How much nicer to allow a soft diffused light to filter through it and illuminate that already futuristic interior!

The roof panel proved so light in weight that it seemed a good idea to make it easy to remove in service. A system of six attachment points was devised so that it could either be taken off entirely or could be raised an inch or two for really copious ventilation. Alas, it was found that the car lost some of its stiffness after a while if it were driven around in either condition. Within a matter of months the roof panel became a fixture, and one of steel.

The shape was not changed. It had involved some distinctive guttering and strengthening around the doortops, and somebody had seen that this potential eyesore could be turned to good account by leading the lines into a pair of rear lamps mounted at roof level. Such features ensured that the world at large was simply flabbergasted by the external appearance of the DS; having grown accustomed to cars that looked like derivatives of the horse-drawn carriage. It was not easy to accept that a car should actually look like the DS. In 1955 there were still aircraft being made that looked more like horsedrawn carriages than the DS did.

> *'... the world at large was simply flabbergasted by the external appearance...'*

Some designers found that streamlined bodies suffered a grievous loss of directional stability at high speeds; the centre of pressure of a classically streamlined body moves well forward as the relative airspeed increases, and once it went ahead of the car's centre of gravity there was a danger that the two ends of the car might try to change places. In the DS, there was no such danger; the shape was aerodynamically right, as well as dynamically right, despite the narrow rear track. Front-wheel drive meant that the rear wheels and tyres had relatively little work to do, so they could be tucked in out of the way and out of the wind, and the tyres could be

MODEL
Citroën DS (1961)

UK price when announced:
£1745

ENGINE
Location: Front longitudinal
Type: Water-cooled in-line four cylinder with aluminium head and cast iron block
Cubic capacity: 1911 cc
Bore × Stroke: 78 mm × 100 mm
Compression ratio: 8.5 : 1
Valve Gear: 2 Valves per cylinder operated by single block-mounted camshaft, pushrods and rockers
Fuel supply: Single double choke Weber 24-32 DDC carburettor
Ignition: Coil and distributor, mechanical
Maximum power: 83 bhp (DIN) at 4500 rpm
Maximum torque: 104.88 lb ft (DIN) at 3500 rpm

TRANSMISSION
Layout: Gearbox and transmission ahead of and in unit with engine
Clutch: Single dry plate, hydraulically operated
Gearbox: Four speed manual with synchromesh on top three ratios
1st 4.16 : 1 3rd 1.44 : 1
2nd 2.10 : 1 4th 1.00 : 1
Final drive: Spiral bevel
Ratio: 3.31 : 1

SUSPENSION
Front: Independent with upper and lower control arms, pneumatic 'spring' and anti-roll bar
Rear: Independent by trailing arm and pneumatic 'spring'

STEERING
Type: Rack and pinion, hydraulic assistance

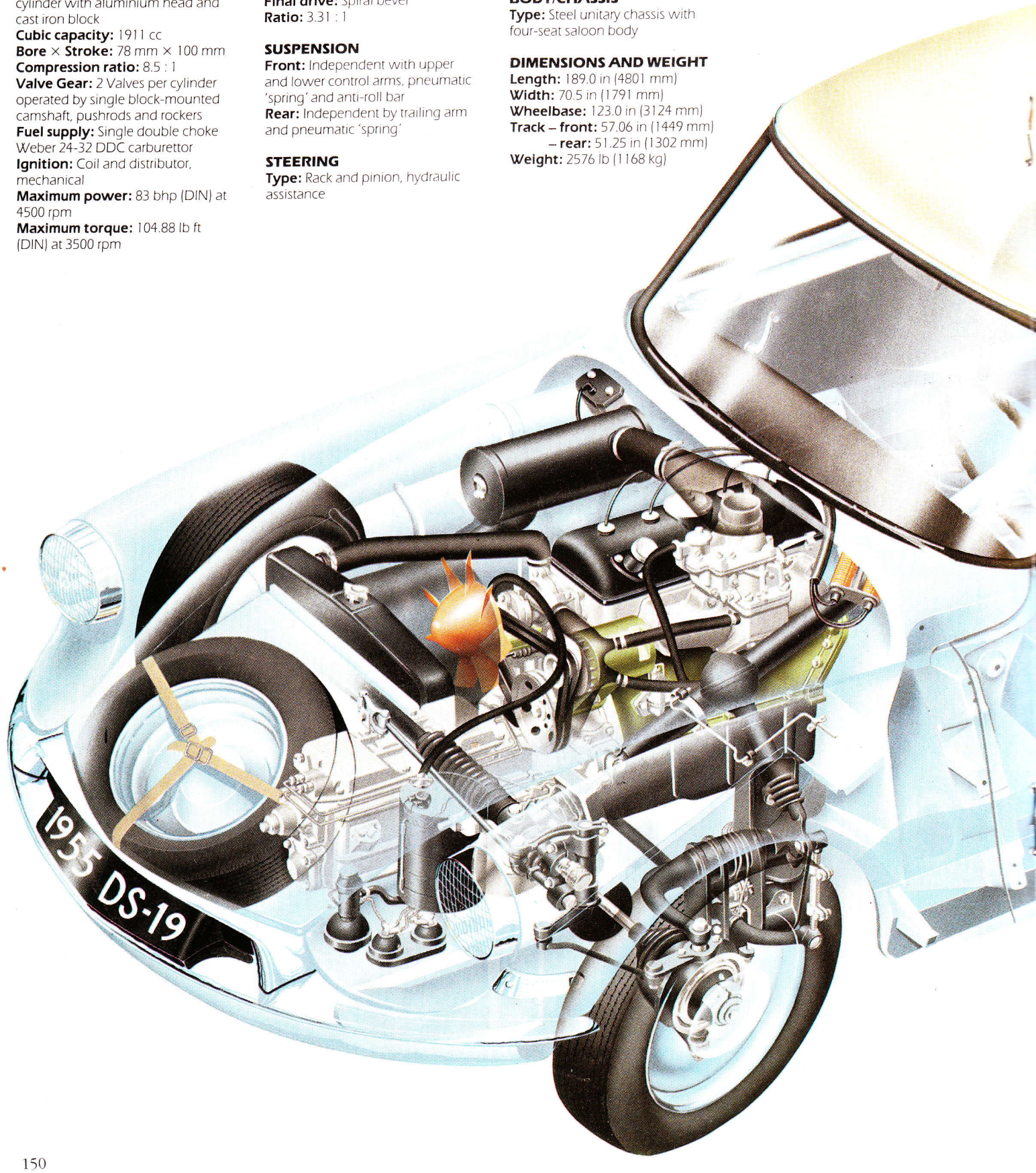
BRAKES
Type: Citroën inboard discs front with drums rear, hydraulically operated

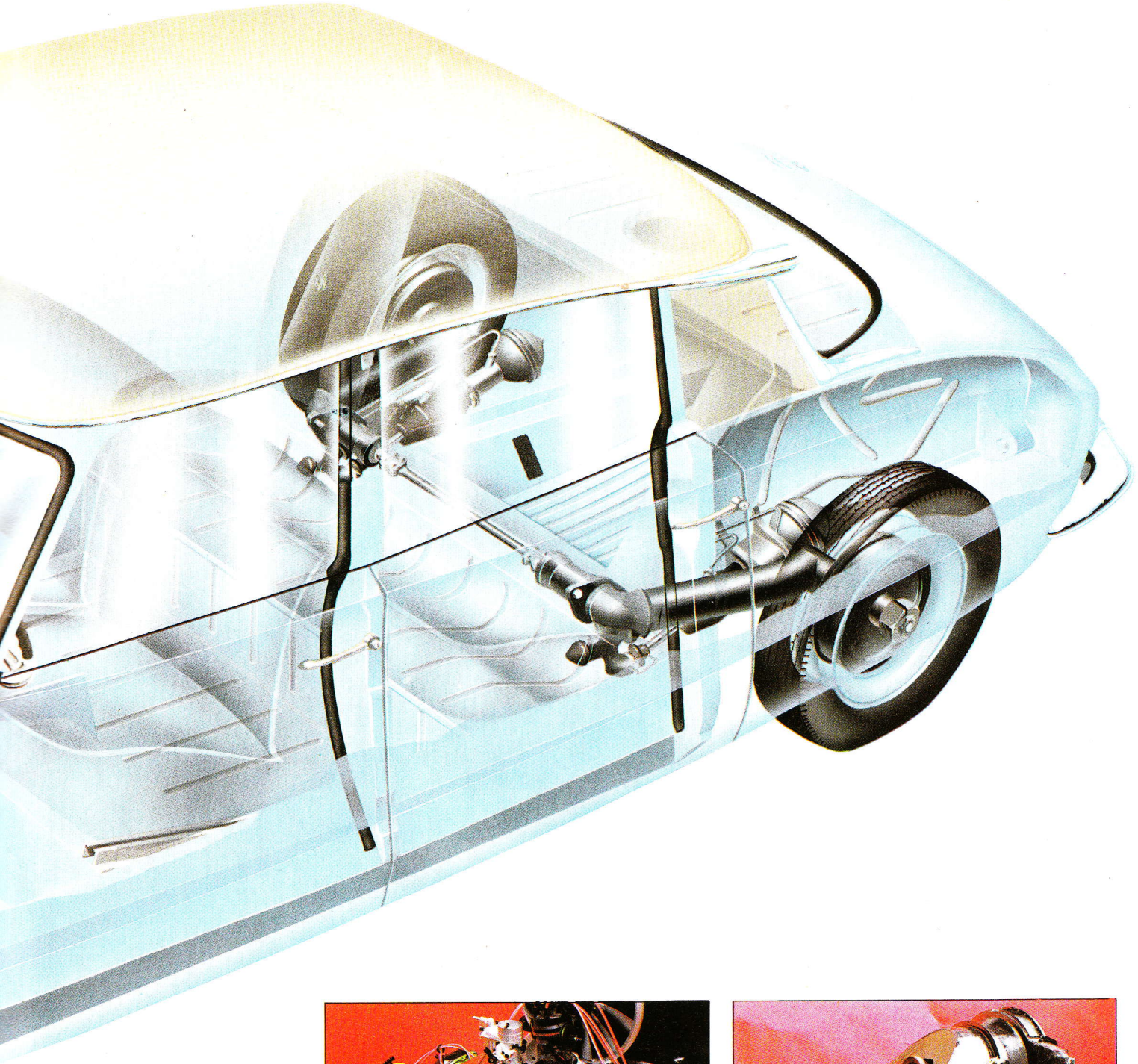
WHEELS AND TYRES
Type: Pressed steel wheels with 165 × 400 mm Michelin X radials

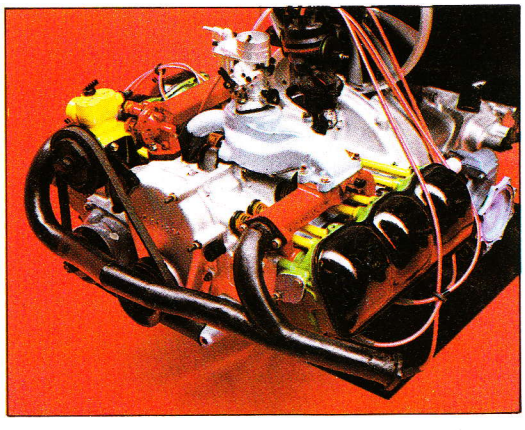
BODY/CHASSIS
Type: Steel unitary chassis with four-seat saloon body

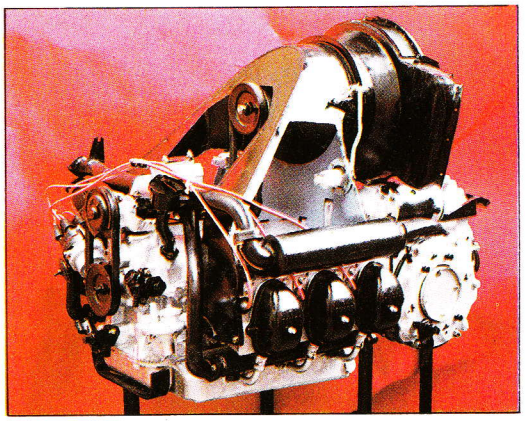
DIMENSIONS AND WEIGHT
Length: 189.0 in (4801 mm)
Width: 70.5 in (1791 mm)
Wheelbase: 123.0 in (3124 mm)
Track – front: 57.06 in (1449 mm)
– rear: 51.25 in (1302 mm)
Weight: 2576 lb (1168 kg)

PERFORMANCE
Maximum speed: 95 mph (153 kph)
Acceleration 0–60 mph: 18.4 seconds
Fuel consumption: 29 mpg









Walter Becchia designed two new engines for the original DS. Both were flat sixes, one water cooled **(RIGHT)** and one air cooled **(FAR RIGHT)**. One was carburetted and one fuel injected but unfortunately Citreön used neither, on the grounds of expense

even slimmer than those at the front. They had to be Michelin X tyres. Nothing else, insisted Citroën, would do. In fact the warranty was expressly made conditional on these still-modern radial-ply tyres being worn, but then Michelin were in charge ... .

As Citroën saw it – and they saw it a good deal more clearly than anybody else – the traditional conventional suspension systems of the world's other cars could never be satisfactory. While the world's other designers went wringing their hands and crying piteously that the compromises they were being asked to make were impossible, that good roadholding could not be combined with comfortable ride, that any approximation to them was more expensive than the cost accountants would allow, and that they were caught in crossfire between the public on one side and the laws of nature on the other, Citroën's designers committed themselves to the one and only kind of suspension that could be seen to promise more than compromise.

Employing two fluids, one gaseous and one liquid, and tapping power from the engine to energize the circuitry whereby they communicated with the wheels, Citroën produced a system offering a constant ride height, an almost constant spring frequency which corresponded to a soft ride, a spring stiffness that increased as the load borne by the relevant spring increased, an integral damping system which was not only speed-sensitive but also nearly load-related and unlikely to deteriorate with age, fully independent springing of all four wheels without demanding much space, resistance to pitching, adjustability of ground clearance to suit rough terrain, automated jacking for wheel-changing, and dependably stable handling up to the limits of the car's inherently excellent roadholding.

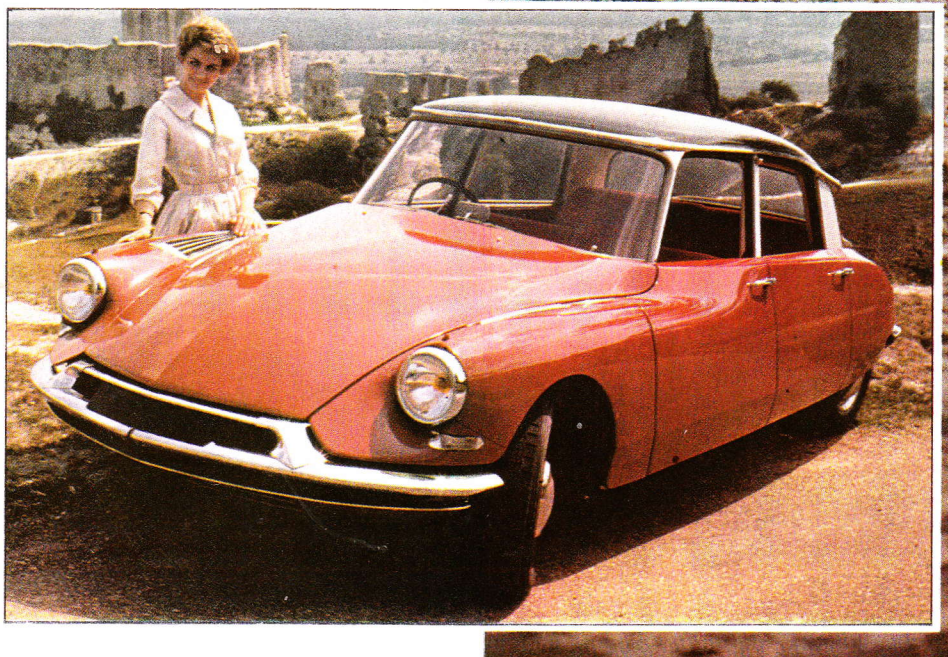
> *'... springing so soft that the ride remained blissfully comfortable...'*

To ensure properly progressive spring rates, Citroën abandoned steel springs and sat the car on four bubbles of nitrogen trapped above flexible diaphragms in steel spheres. As a diaphragm was pushed up by the corresponding wheel rising over a bump (or by an extra passenger or luggage adding to the load carried by the gaseous 'spring'), the gas would be compressed; but since complete compression would be physically impossible, each increment of compression absorbed more force than the last, so the stiffness or resistance offered by the nitrogen spring to compression of the suspension increased as the square of the increase in load. No feasible load could overcome it, and yet when the car was almost empty the springing was so soft that the ride remained blissfully comfortable.

What actually forced the diaphragm up against the gas was no clumsy metal linkage but a rising column of oil in a cylinder sealed at the bottom by a piston linked to the suspension arm. Inside this cylinder (at the base of the sphere) was a plug sandwiched between two washers and incorporating calibrated orifices, all very precisely made: this was the damper, inhibiting the flow of fluid. The faster the flow, the greater the damping resistance – conveniently offsetting the tendency to excessive damping at low load.

What made the DS even more superior was the incorporation of self-levelling to maintain a constant ride height regardless of load. It offered many benefits, not least that the centre of gravity could be kept low (for better roadholding and handling, and incidentally for reduced pitch and roll and therefore better comfort) but not forgetting little things like maintaining correct alignment of the headlamp beams. How Citroën achieved it was simply by varying the length of the column of oil between piston and diaphragm.

That column of oil was in effect a liquid pushrod. By pumping more oil into the cylinder, thus forcing down the piston, the 'rod' could be made longer – liquids are incompressible – and the movement of the arm carrying the wheel itself controlled the valve which admitted the oil. It also tapped oil off to shorten the column whenever it was appropriate to reverse the procedure. Obviously the oil had to be pumped at high pressure: the engine drove a small pump to effect this, the pump drawing fluid from a large underbonnet reservoir and forcing it into a pressure-accumulator which was another sphere, the hydrogen compressed



BELOW *The Citroën DS shape changed hardly at all over two decades although air intakes were featured in the curvaceous wings from 1958 to '61*
RIGHT *The Safari Estate versions with self-levelling suspension coped admirably with the heaviest of loads*
BELOW RIGHT *A 1966 'decapotable'*

EVOLUTION

Introduced at the Paris Motor Show on 6 October 1955 in four-seat saloon form with 1911 cc four-cylinder engine and revolutionary hydropneumatic suspension and powered clutch and steering.

1957 The cheaper and less sophisticated ID introduced with same engine but less power (62 or 66 bhp) and maximum speed of 84 mph (1355 kph). The ordinary ID was quickly followed by the Confort.

1958 DS Prestige introduced in September with partition, radio and radio telephone and the first ID Estate and Ambulance versions appeared in October.

1960 DS Drophead introduced.

1961 Power output of DS19 increased to 83 bhp and top speed to 93 mph (150 kph). New fascia introduced.

1962 New bumpers and optional mechanical gearbox control

1964 Pallas introduced with more comfort and two extra halogen headlights.

1965 DS21 introduced with 109 bhp 2175 cc engine and dynamic headlight control. DS19 given 1985 cc engine.

1966 ID19 receives 1985 cc engine.

1968 DS20 replaces DS19.

1969 Electronic fuel injection fitted to DS21 to bring power up to 125 bhp. Top speed increases to 117 mph (188 kph). DS production reaches one million.

1971 5-speed gearbox introduced on DS21 and D Super. Borg Warner automatic gearbox available.

1972 DS23 introduced with 115 bhp 2347 cc engine (130 bhp with fuel injection). D Super 5 appears with 2175 cc engine and 5-speed gearbos.

1975 DS range replaced by CX.

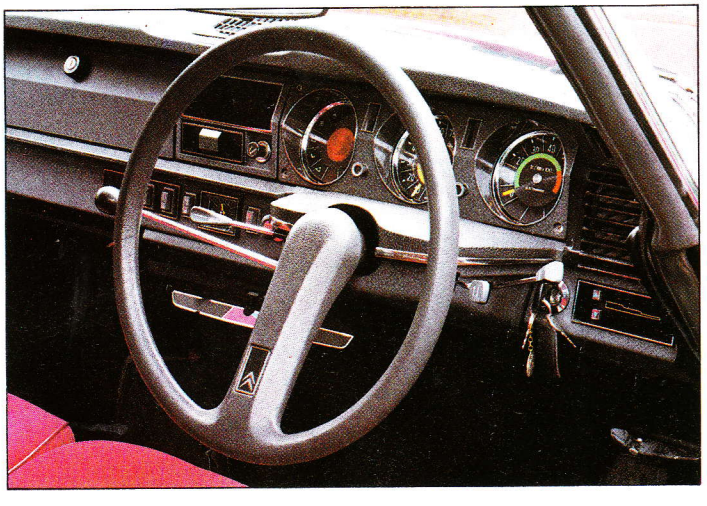
to 175 bars to balance the pressure of the oil on the other side of its diaphragm. From this accumulator, the oil was ready to be piped and valved instantly into whichever suspension strut needed it.

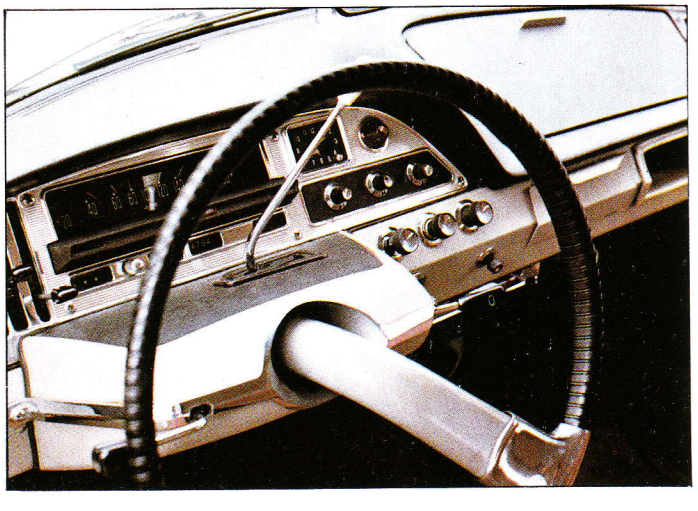
Given this source of power, there was so much more that could be done with it. Praise be, Citroën did not shirk the task. The high-pressure hydraulics were tapped to operate the brakes, the clutch, the gear-change, and the steering servo, with the brakes and steering having priority over the suspension, in case a leak somewhere might deplete the accumulator.

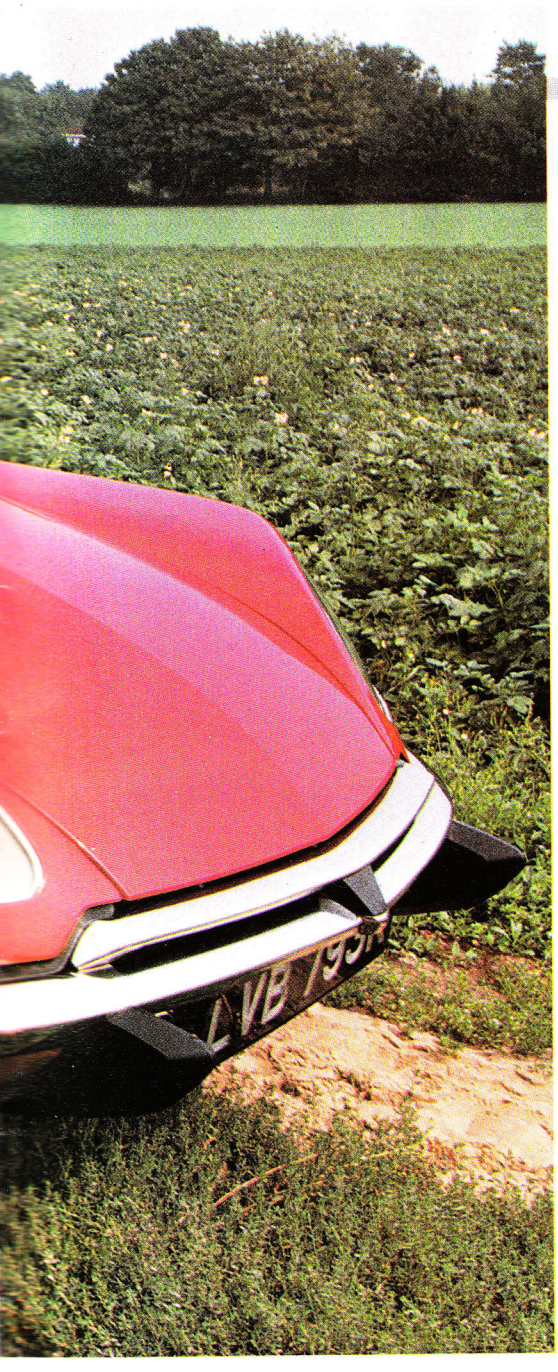
Engines were uprated and modified from time to time, growing from 1911 cc first to 1985 then (for the DS21) to 2175 and eventually (for the DS23) to 2347 cc. Three years after the 1966 introduction of the DS21, fuel injection became available on the top models, the last and fastest DS being the injected

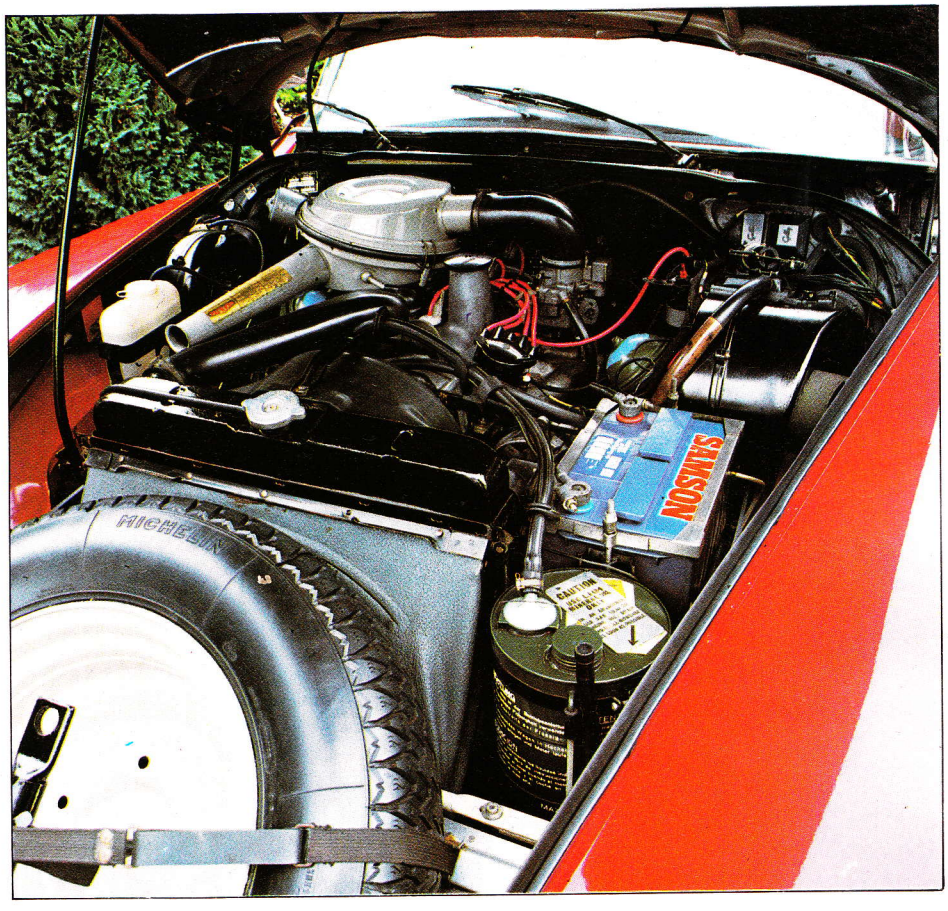
ABOVE *A 1972 D-Super. That was the replacement for the base-model ID. This car featured a 1985 cc engine with five-speed gearbox as well as the famous swivelling headlights which turned with the steering to see around corners*

BELOW *The dashboard of a 1961 DS which hardly looks 20 years old. The gearlever protruding from the dashboard selected the gears semi automatically and, when pushed to the far left past neutral, would engage the starter motor*









The brakes were tremendously powerful by 1955 standards. At the front, and mounted inboard to reduce unsprung weight, were two large discs, some of the first to go into production. Other manufacturers shopped with Dunlop or Girling or Lockheed or somebody for brakes; Citroën made their own, calipers and all, along with the first anti-panic brake-lock inhibitor for the rear wheels. They also incorporated a purely geometrical anti-dive effect by feeding rear brake torque into the trailing arms which carried the rear wheels, so that the tail of the car should actually squat slightly when the brakes were used hard. It gave a very reassuring feeling – and the customers needed all the assurance they could get, so unconventional was the brake pedal in size and feel.

It was hardly a pedal, just a mushroom-like button on the floor next to the accelerator, and it moved only about 3 mm, because it was not transmitting effort, merely opening a valve. The valve opening was proportional to foot pressure, not to pedal travel, and through it coursed that high-pressure fluid to operate the brakes, returning by another route (as with the suspension and other circuits) to the reservoir; customers with stubbornly closed minds complained bitterly about it.

Power-assisted steering, however, was not such a rarity. Anyone who thought for a moment about how heavy (or, alternatively, how awfully low-geared) the steering of the DS would have to be, if there were no servo to help haul it around beneath all the weight concentrated on the driving wheels, did not complain about this feature.

The assistance rendered by the powered hydraulics to the transmission caught the public in two minds. For the clutch, there was no pedal at all; everything was controlled by the slender wand which served as a gearlever, sprouting from a gated quadrant on the steering column. Press the lever one way, and the engine started. Shift it in any other direction and it freed the clutch. Slot it into, say, first gear position, and that gear was engaged. Release it, and the clutch was engaged at a predetermined rate. It could be made to give very smooth results with a bit of practice, but not many owners knew that the clutch engagement rate could be adjusted to make for quite brusque and racey gearchanges.

'... Citroën had taken the car when it was a motorised cart and transformed it into a magic carpet'

In sad fact, not many customers knew much about the DS at all. Even enthusiastic Citroën owners admitted that the car was very complex and could therefore be very costly to maintain. Those few who took the trouble found that it could be maintained in perfect health without any previous experience or mechanical skills; all that was necessary was sufficient intelligence to read and understand the workshop manual but apparently not all the mechanics at Citroën dealerships had that particular ability.

Despite all these misgivings, people were attracted to the DS. Maybe that sad little old iron-bellied engine sitting all forlorn amidst the plumbing of the future did only rattle out a mere 75 bhp, but the pickaxe DS clove the air so cleanly that it could cruise beyond 90 mph (145 kph), and it did not have to slow down when the *pavé* was rough. In one grand gesture, Citroën had taken the car when it was a motorised cart and transformed it into a magic carpet.

The things most subject to change in the course of the production history of the DS were the engines, the transmissions, and the interior furnishings, and accordingly they must be judged the things that did not really matter to the concept of the car as a whole. More important was the change in the nasal shape which took place in 1967, when the headlamps were faired in and the contours of the nose refined (especially underneath) to make a significant reduction in aerodynamic drag. The fact that the DS acquired four headlamps at the same time, and that the

inner mainbeam lamps of the more expensive versions swivelled with the steering and were given a fast-responding self-levelling system of their own (worked out by Cibié), were as incidental as they were notable.

To summarise all the changes is not easy, for there was a proliferation of variants which often overlapped for years at a time. For a start there was the ID19, a cheapened version with conventional transmission, in 1957, followed by the magnificent Safari estate car.

23, good for well over 120 mph (193 kph) and able to reach 60 in half the 20.4 seconds needed by the 1955 car. There had to be complementary transmissions for all these: as well as the semi-automatic and unassisted versions of the four-speed synchromesh box, there was a five-speeder, and a Borg-Warner automatic. The ID at the cheap end of the range became the D Super, which is merely advertising language; at the other end of the scale, coachbuilder Henri Chapron created a drophead cabriolet body which demanded fluency in the cheque language and a deaf ear to the aerodynamicists' bad language!

How much more might have been said, had Citroën felt commercially able to put into production the changes that they had in mind, changes that would have made complete and final sense of the powered hydraulics and pneumatics which, even in the DS, were not fully exploited. Take the suspension for example. The earliest DS was limited to a lateral acceleration of about 0.4 g, before the anti-roll bars were stiffened; but those bars, being undamped steel springs of course, were evidence that the DS suspension system was not yet perfect. In fact it had a naturally very low roll stiffness, only partially countered by the very wide front track and the low centre of gravity. But what Citroën had planned (and built, in prototypes) was an active suspension. All the necessary plumbing was there, except for the control valving which would sense the car's rate of change of attitude in response to any manoeuvre or road irregularity and signal the suspension to lift or lower wheels correspondingly. Today such systems are known to be under test by Lotus but Citroën had the basis of the system ready nearly three decades earlier, ready to eliminate roll and pitch, to keep the wheels upright at all times, to give an even more astonishing ride in conjuction with much more astonishing roadholding.

> *'... in fifteen years or so we may look back on it as the Car of the Century'*

As it was, the DS did very respectable things in rallying, especially when the rally was a long one over tough terrain. The firm's first official entry of the DS19 in competition gave them first and fourth places and the manufacturers' team prize in the 1959 Monte Carlo Rally, and at the end of that year their driver Coltelloni was European Rally Champion. A DS won the Tulip Rally the following year, but more significant were the 2nd and 4th places taken in the East African Safari. Most significant of all, since the event was the toughest in the calendar, was Citroën's victory in the Marathon de la Route, which in 1961 was from Liège to Sofia and back.

The object of the organizers of the Marathon was to make it so tough that only one car survived to win it. From a couple of hundred starters in 1962, 18 finished unpenalised and four of them were DS Citroëns, earning a class win and team prize, in a year that also saw success in the Alpine, Norwegian Winter, Lyons-Charbonnières and Thousand Lakes rallies, not to mention the Scandinavian Rally Championship. All these rallies fell to Citroën again in 1964, along with the Monte Carlo and Liège–Sofia–Liège team awards, and only from 1964 did the prodigious roadworthiness of the DS begin to be inadequate by itself in securing international rallying victories. Nevertheless the car's most convincing showing was yet to come. In 1968, the London–Sydney Marathon took its competitors over what was obviously a very long and very punishing route, and just 100 miles (161 km) from the end of it a DS was well in the lead. At that point, sad to say, the car was wrecked when hit head-on by a local car in traffic.

Even in that most competitive of environments, the market place, the fortunes of the DS were beginning to abate somewhat. Those who understood them still appreciated them; the rest fell year by year easier prey to the calumnies and superficial enticements of rival manufacturers. Two decades sufficed, as they had for the *Traction*; in 1974, the CX came forward to take its turn, and (since it embodied all the concepts of the DS, albeit in up-to-date expression) it was deservedly acclaimed Car of the Year. The DS which put it there disappeared from production; but in another fifteen years or so we may look back on it as the Car of the Century. LJKS

A DS Citroën on the Monte Carlo Rally in 1970. By that time the DS was no longer really competitive in international rallying