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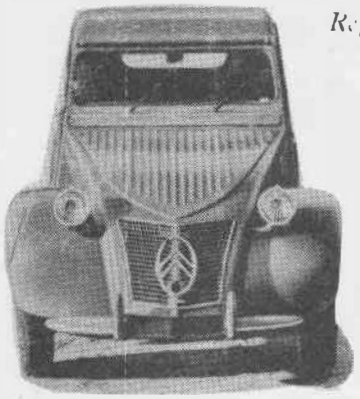
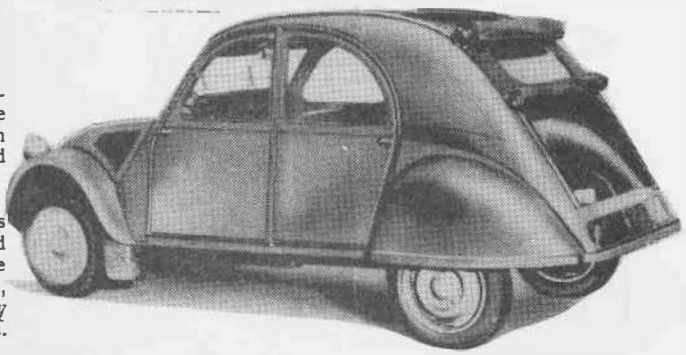


Left : The characteristic washboard ridges on the bonnet are among many features which have excited widespread controversy.



Right : Here seen with its folding head rolled back and the fabric cover over the luggage compartment furled, the 2 c.v. Citroen offers utility motoring in its simplest form.

THE 2 c.v. CITROEN

A TECHNICAL REVIEW OF THE MOST ORIGINAL DESIGN SINCE THE MODEL T FORD

ALTHOUGH *The Autocar* was able to publish the first detailed Road Test of the 2 c.v. Citroen in the issue of January 23, 1953, many of the interesting mechanical features of the design have not yet been dealt with in detail, and the accompanying illustrations have therefore been made to reveal the extraordinary ingenuity of this design, which is undoubtedly the most original since the Model T Ford.

When it was first exhibited, the car was regarded by many Frenchmen as a joke, and it inspired a large number of music hall witticisms, but the thousands now on the road have performed so well that the jokes are heard no longer. The 2 c.v. is now the most sought after car in France, and the only one that sells at a premium second-hand. There seems to be a definite 2 c.v. cult in course of creation and an extraordinary spirit of cameraderie exists between owners. They wave to each other on the road and eagerly exchange experiences whenever they meet.

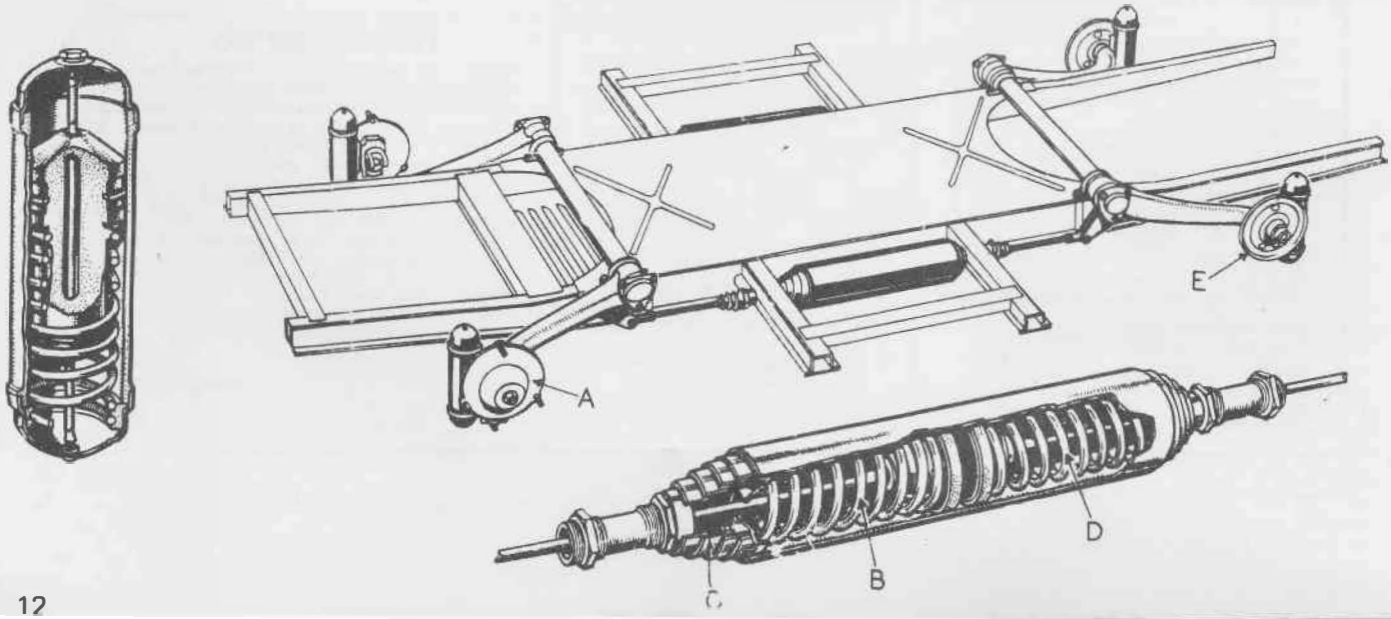
Originally the 2 c.v. was designed as a runabout for people in rural areas who could not afford conventional cars, and utility rather than beauty was the guiding principle in its design. It was planned to run for long periods with little attention and was intended to stand up to the worst abuse to which it could be subjected by buyers who had never driven cars before. It has done this so well that it has now excited the interest of the more sophisticated town dwellers and its popularity is limited solely by the output, which at present is gradually increasing towards 200 a day.

Real Utility

The conception established by the late M. Boulanger, then in charge of the Citroen destinies, was that of a small car providing comfortable travel for four people and luggage, over all types of road and rural cart track. Speed and hill-climbing were not important, provided they were superior to those of the pony and cart which the car was designed to replace, but fuel consumption must be 55-60 m.p.g. In fact, the target fuel consumption has been realized and the maximum speed on the level proves to be about 40 m.p.h., which can be sustained for as long as conditions allow, without danger to the mechanism. Moreover, the 2 c.v. has proved capable of climbing the highest Alpine passes, albeit at a modest gait of some 10 m.p.h. Its leisurely pace when climbing mountains still produces patronizing smiles from occupants of more powerful cars, but once over the top of the pass, their expressions change, for there are scarcely any cars of any size that can keep pace with a 2 c.v. in competent hands down a twisting mountain descent. Its hydraulic brakes, with a lining area of 65 sq in, are exceptionally large in relation to an unladen weight of only 1,106lb and give it a margin of stopping power which is enjoyed by few other family cars regardless of size or cost.

The 2 c.v. resembles the larger Citroens in having front-wheel drive, but in practically no other respect. The engine is an air-cooled, flat twin mounted ahead of the front wheels and many people think it resembles a motor cycle engine, but the resemblance is only superficial, for this little power unit is built to safety factors usually associated with heavy truck engines. By restriction of the inlet manifold cross section, the output for a swept volume of 375 c.c. has been kept down to

Basic chassis structure and suspension system of the 2 c.v. Citroen. Projecting arms at front and rear are connected to spring units at the centre of the chassis. When the front wheel arm A strikes a bump, its connecting rod compresses the coil spring B. This draws the cylindrical casing forward against the action of the volute spring C and partially compresses the rear wheel spring D, bracing the rear wheel E to resist the shock of the bump. The inset shows the construction of the inertia dampers, in which a cast iron weight acts in conjunction with a coil spring to eliminate wheel patter.



9 b.h.p., or a mere 24 b.h.p. per litre, and the engine is capable of running at full load for long periods. It is not unusual for production engines to be run on full throttle continuously for 100 hours or more in factory bench tests. The car is a brilliant example of simplification, but there are certain features which are not found even on more expensive models. The engine has hemispnerical combustion chambers. The cooling fan which supplies air through ducts to the cylinder barrels and heads is very generously proportioned and it is supplemented by an oil cooler. Moreover, driving is simplified by a gear box which has synchromesh for all four forward speeds. It is emphasized that these things are not luxuries; they are essential to the conception of a reliable car, capable of standing the hardest use in unskilled hands.

The engine is designed to run on the lowest grade fuel; indeed this is recommended because the smaller the lead content, the longer the valves can be expected to run without trouble. In its general layout, with its light alloy crankcase split on the centre line, two-throw counterbalanced crankshaft and light alloy heads, it is not startlingly unusual, but there is no ignition distributor. A simple contact breaker, built into the front end of the crankcase, is driven direct off the end of the camshaft and a twin coil unit clipped to the head lamp cross bar supplies sparks continuously to both plugs, so that these fire on the power stroke and on the exhaust stroke.

Another remarkable simplification is the construction of the dynamo, which has no bearings. The dynamo casing, carrying the permanent magnets, is spigoted into the crankcase, and the dynamo armature fits on a taper on the front end of the crankshaft. The fan is then inserted into a reverse taper on the end of the armature, and the whole assembly is drawn together by one bolt. A starting handle dog is incorporated in the hub of the fan.

To compensate for the pressure fluctuations in the crankcase caused by movement of the pistons, a small steel flap valve is fitted in a branch passage off the oil filler, from which a pipe takes the escaping fumes up to the carburettor air cleaner. The carburettor is a Solex downdraught, feeding into a welded steel manifold, the cross section of which has been deliberately calculated to restrict the total power developed, and directly below the carburettor is an exhaust heated hot spot.

No cotters are used to secure the valve springs. The valve collar has an offset hole which is slipped over the end of the valve stem and is then moved sideways to register with a flat on the stem. The valve gear is enclosed by an oil-tight aluminium cover resting on a synthetic rubber seal on the aluminium cylinder head. The oil pump, which consists of a gear engaging with an internally toothed eccentric ring, is driven off the rear end of the camshaft and the pump housing forms the rear camshaft bearing. Effective temperature control is provided by the cooler already mentioned, but in addition, there are cooling fins on the lower face of the sump, which has a capacity of two litres.

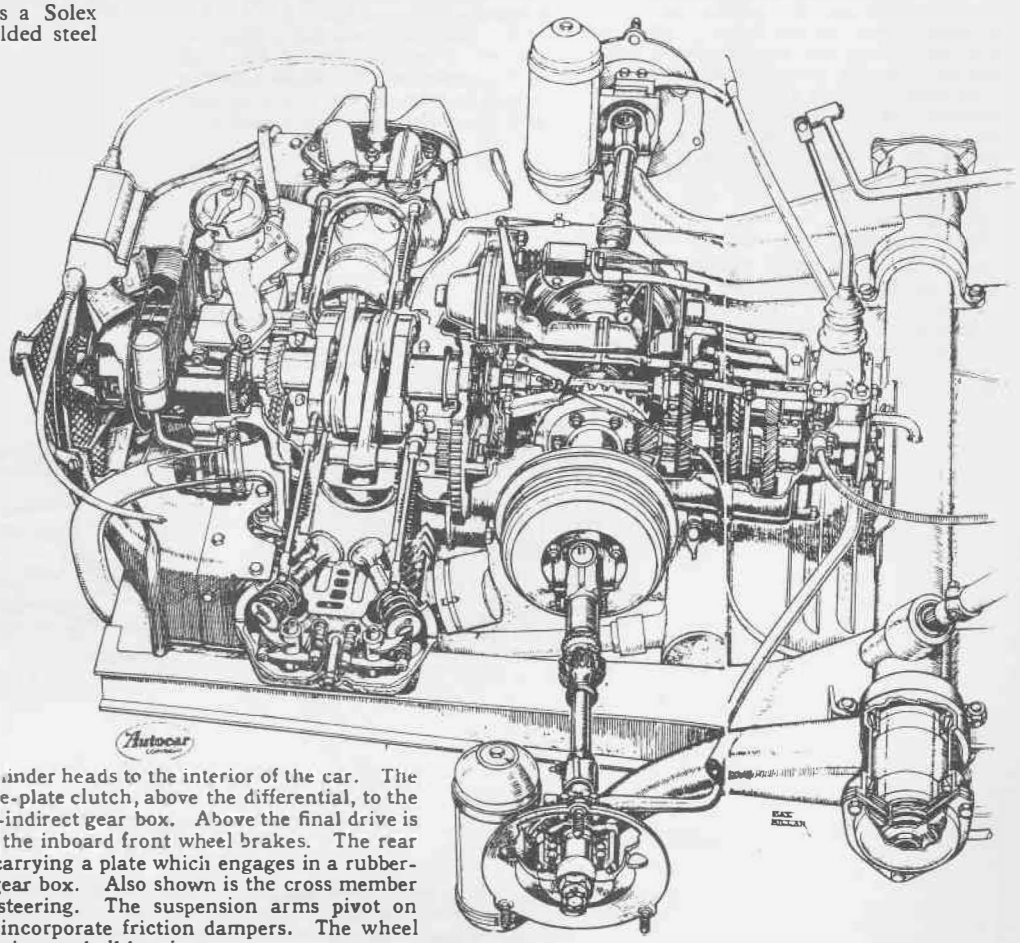
The dimensions of the engine bearings testify to the manufacturer's concern for long life between overhauls, the mains being cast bronze shells with white metal linings and the big-ends being copper lead shells. The crankshaft is made in three pieces. The connecting rods are assembled on the crankpins integral with the front and rear portions of the shaft, and then the two crankpins are forced into the oval central web by hydraulic pressure. Thus the assembly can be stripped only at the factory, and if trouble arises it is replaced by a reconditioned unit.

Unique Suspension

The single-plate dry clutch and the layout of the gears in the all-indirect gear box conform to normal front wheel drive practice. The spiral bevel final drive has a ratio of 3.87 to 1 and the overall ratios are 5.7, 7.5, 12.56 and 25.9 to 1. The drive shafts to the front wheels have simple needle roller universals at each end, no constant velocity joints being deemed necessary at the powers and speeds concerned. The suspension system is unique in its whole conception, and within its performance range the Citroen has exceptionally good road holding, with a degree of riding comfort over really rough surfaces which is not attained by any other small car. Much of the credit for the results obtained must go to the inertia dampers, one of which is fitted adjacent to each wheel. The damper consists of a steel cylinder housing a cast iron weight of about 7¼lb which rests on a coil spring. As the wheel rises, the weight descends in the cylinder and compresses the spring against the bottom of the cylinder, thus resisting the wheel movement. The damper is only intended to suppress the wheel patter which can arise with such a light assembly; deflections of greater amplitude are dealt with by the friction dampers built into the pivots of the suspension arms. A small quantity of oil in the cylinder is forced up the central guide tube by the descending piston and sprayed over the cylinder walls as a lubricant, but it has no part in the damping action.

It will be noticed that the arms carrying the wheels are connected to the coil suspension springs in a way which tends to confer a progressive rate as the wheels rise, and there is a degree of inter-connection between front and rear wheels. The front wheel steering pivots are mounted entirely below the hubs and the castor angle varies with the load on the car. With the car empty, there is a positive castor of some 14 degrees, but with two people on board this is increased to 22 degrees. The wheelbase also varies with the load; unladen it is only 93.3 inches, but extends to 95.6 inches with four people and 110lb of luggage.

Criticism of the Citroen's angular and ungraceful appearance has been largely stilled by its economy and proved durability in hard service, but there are still some who feel that its flat panels, its harsh lines and the washboard ridges on its bonnet make it unnecessarily ugly. The rea-



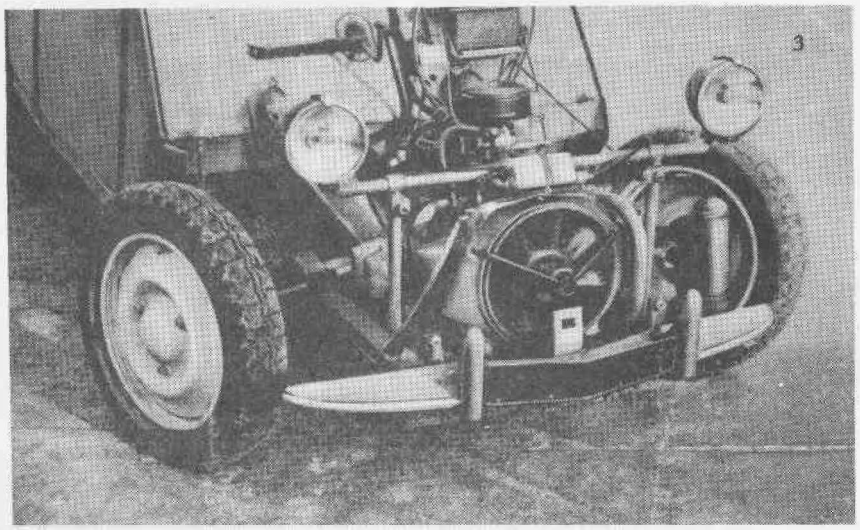
The engine, gear box and front drive assembly of the 2c.v. Citroen is cut open, revealing the offset cylinders and two-throw crankshaft. In front is the dynamo, carrying on its nose the cooling fan, and above it is the oil cooler. Air ducts from the fan lead to the cylinder barrels and heads. Pipes at the rear take hot air from the cylinder heads to the interior of the car. The drive shaft passes from the single-plate clutch, above the differential, to the four-speed, all-synchromesh, all-indirect gear box. Above the final drive is the starter and on each side are the inboard front wheel brakes. The rear engine mounting is a small peg carrying a plate which engages in a rubber-lined socket on the end of the gear box. Also shown is the cross member housing the rack and pinion steering. The suspension arms pivot on twin taper roller bearings and incorporate friction dampers. The wheel hubs have twin row ball bearings.

son is associated with the conditions under which it was evolved. Preliminary work began on the project before the war, but the car as now built was designed during the German occupation, at a time when it seemed likely that the factory would be left with few tools or presses of any value to resume car production. The body and basic structure were therefore designed to be produced with the minimum employment of press tools. The suspension and main mechanical elements are attached to a simple frame of steel sheet formed largely by folding, and to this there is attached by spot welding a body which represents the simplest enclosure capable of protecting four people and their luggage from the elements. The seats are formed of light pads supported on rubber bands stretched across a light tubular frame. Doors and bonnet have no conventional hinges; they are simply joined by interlocking flanges at their edges which serve the purpose equally well. By lifting out the pins holding the check straps, and removing the two screws which secure the caps over these flanges, all four doors can be slid upwards and removed from the car in a few seconds. All panels are protected against rust by a phosphate coating.

Low Running Costs

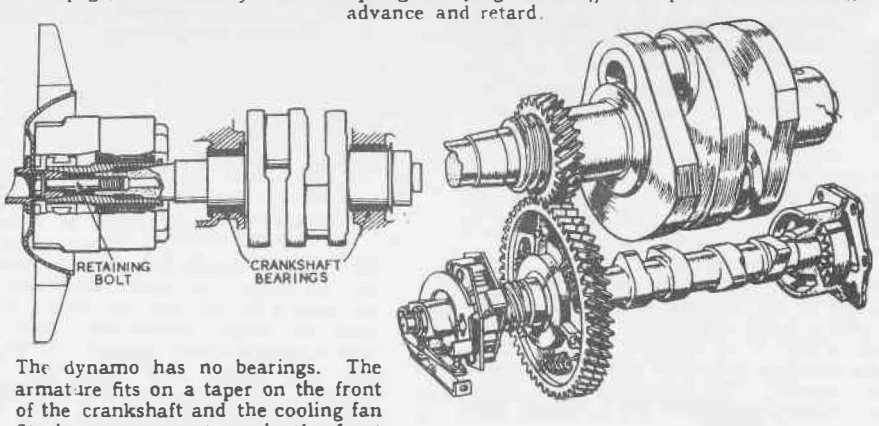
Apart from the inherent merits of the car as a sturdy means of day to day transport for the man whose car must earn its keep, the operating costs go far to ensure its popularity. Decarbonizing, an operation within the capacity of most handymen, is necessary only at intervals of about 12,000 miles and at the same time it is a simple matter to slide off the cylinder barrels and check the piston rings. The normal life of pistons, rings and cylinders is reckoned to be about 36,000 miles, and a complete replacement set can be bought for £7 12s 6d. The car is delivered with a free insurance on a third party, fire and theft basis for five days, sufficient to cover the delivery period and enable the owner to complete his own arrangements, and the annual insurance premium asked for the 2 c.v. is some 30 per cent below that for its nearest competitor. In any case, casual damage to bodywork presents few terrors when a complete new front wing can be bought for £2 14s and a rear wing for £2. It is not worth the trouble of repairing them. The engine exchange system operated by the French Citroen factory also presents unusual features, for there is no fixed charge: the owner is charged only with the cost of the work found necessary to restore his own engine when it is finally dismantled. Meanwhile he has his new engine fitted without delay.

At its present price of 341,870 francs (£346) the Citroen is assured of a steady demand in France, but there is good rea-

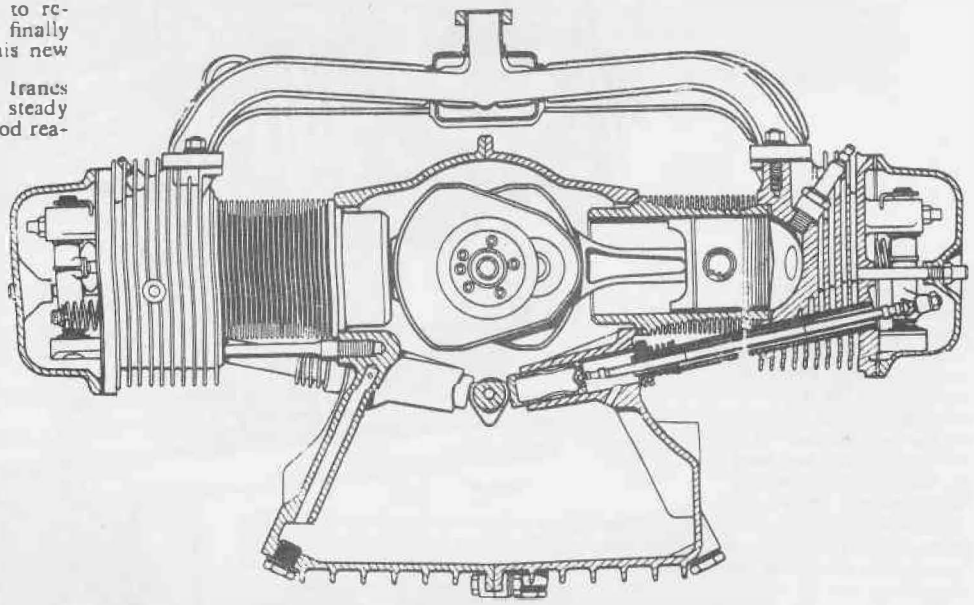


By easing two thumb screws and using the wheel brace to slacken off four nuts on each side, the bonnet and front wings can be removed entirely in one minute, giving access to power unit, transmission, suspension, steering and brakes.

Any back-lash which may develop in the timing gear is taken up by the use of a split gear on the camshaft. The two halves, one fixed and one free on the shaft, are joined by coil springs which maintain an even pressure on the drive gear teeth. The oil pump is on the rear of the cam-shaft. At the front is the ignition contact breaker, which is built into the crankcase. The drive to the cam is transmitted through four pegs, connected by two leaf springs carrying bob weights to provide a centrifugal advance and retard.



The dynamo has no bearings. The armature fits on a taper on the front of the crankshaft and the cooling fan fits into a reverse taper in the front of the armature. The whole assembly is held together by one retaining bolt, and runs safely up to over 5,000 r.p.m.



A section through the engine, showing the aluminium crankcase split on the centre line and the cylinders, which are spigoted into the crankcase and secured by long bolts passing through the aluminium heads. The varying depth of the cooling fins on the cylinder barrels is interesting and also the small section of the inlet manifold, with its exhaust-heated hot spot.

son to suppose that with increasing employment of mechanized production methods this price can be progressively reduced. Indeed, one of the questions exercizing the minds of sales executives in other car factories in France and elsewhere is the fact that no one knows just how cheaply it *could* be sold if competition appeared. Certainly the manufacturers are taking great care to safeguard its growing reputation. They originally planned a larger engine of 425 c.c. for the delivery van version, but abandoned it purely because they thought that many owners would be tempted to fit the larger cylinders and pistons to the saloon model and thus upset the balance of performance and economy, road holding and riding comfort which has been so painstakingly achieved.

SPECIFICATION
2 c.v. CITROEN

Engine.—2 cyl, 62 × 62 mm, 375 c.c. Flat twin, air cooled. O.h.v. in hemispherical light alloy heads with push rod operation. Compression ratio 6.2 to 1. 9 b.h.p. at 3,500 r.p.m. Max torque, 16.6 lb ft at 1,800 r.p.m.

Transmission.—Single-plate dry clutch. Four-speed all synchromesh gear box with facia control. Spiral bevel final drive to front wheels. Fourth speed geared up. Overall ratios 5.7, 7.5, 12.55, 25.9 to 1.

Suspension and Steering.—Independent front and rear. Single leading arms at front, single trailing arms at rear. Coil springs in compression, interconnected between front and rear. Inertia and friction dampers.

Wheels, Tyres, Brakes.—Steel disc wheels with three-bolt fixing. Michelin tyres 125-400 mm. Lockheed hydraulic brakes with leading and trailing shoes. Front drums 7.8in diameter; rear 7.08in.

Dimensions.—Wheelbase (unladen) [illegible] Overall length 12ft 4in. Width 4ft 10½in. Height (unladen) 5ft 3in. Kerb weight 1,100lb.