JAGUAR CARS LIMITED COVENTRY

The
"D TYPE"
JAGUAR

Reprinted from The Autocar
ON the two recent occasions when it has appeared in public, the new
competition Jaguar has been extremely successful. At Le Mans in
June it gained second and fourth placings, beaten only by the Ferrari powered
by a 4,954 c.c. engine, while, soon afterwards at Rheims, it gained the first two
places in the 12-hour Sports Car Race.
The race averages were 105 m.p.h. at
Le Mans (the winning Ferrari recorded
105.1 m.p.h.), and 104.55 m.p.h. at
Rheims. So much for its performance,
but what of the car itself?
How does it compare with previous
competition Jaguars? For example, the
cars that gained first, second and fourth
positions in the Le Mans 24-hour Race
of 1953? The current car is in the direct
descendant of previous models, although there are a number of impor-
tant differences, outlined in the brief
description in The Autocar of May 7,
1954.

There are at least two ways of improv-
ing a given car's performance: by obtain-
ing greater power from the engine, and
by reducing the resistance to motion.
The first method increases the amount
of work required from the mechanical
components; the second can make their
task less severe—both approaches have
been exploited in the D-type Jaguar.

The C-type Jaguar was built around
a tubular frame, the main frame members
taking the stresses, while the body panels
played a relatively small part in providing
structural rigidity. For the D-type, the
design of the chassis has been completely
revised; there is no separate chassis as
such, but the car is built around what
may be called a centre-section of mono-
coque construction and immense strength.
This provides a very rigid structure and
also results in a useful weight reduction.

The Main Structure

To obtain a clear picture of how the
body structure is designed, it is perhaps
easiest to consider it as three sections:
the centre portion, forming the bulk of
the structure; the front section, integral
with the centre section and housing the
ingine and front suspension; and the tail
assembly (containing the fuel tanks and
spare wheel), which is bolted to the centre
section.

The centre section consists of an ellipti-
cally shaped tube in which are cut suit-
able openings for the driver and
passenger. Below the major axis of the
ellipses, extra stiffening is provided by
massive L-section pressings, riveted to
the main section so that they form, in
effect, two tubular members, approxi-
mately triangular in cross-section. Both
ends of the centre assembly are enclosed
by diaphragms which form the front and
rear bulkheads.

At the front, a large box-section member
is provided above the major axis of the
ellipse by the use of two diaphragms and
a lower closing plate. In the front bulk-
head a central opening houses the trans-
mition and provides additional space for
the driver's legs.

The rear bulkhead requires only a
small opening, for the propeller-shaft.
The good torsional rigidity and beam
strength of the centre section is also in-
creased by four tubular members which
extend diagonally forward and are
welded to the front cross-members. These
tubes embrace the complete power unit,
while further stiffening is provided by
two additional square-section tubes which
This drawing of the D-type Jaguar shows the layout of the major components together with the main structural members.

The most noticeable difference in the appearance of the engine is caused by the change from wet to dry sump lubrication, made to reduce the height of the engine, the bump height having been halved. This not only enables the bonnet line to be lowered considerably without adversely affecting ground clearance, but also lowers the centre of gravity of one of the major masses.

It has, of course, been necessary to provide an additional oil pump but, as on the standard engine, the drive is taken from a gear between the front main bearing and the timing chain wheel. The crankshaft gear engages with the gear ring which drives a transverse shaft, operating the pressure pump on the right-hand side of the engine and the scavenged pump on the left-hand side.

Oil from the tank is drawn by the pressure pump and directed to the bottom of the oil cooler. Forced through the cooler, it passes through a rubber hose to the crankcase where it lubricates the bearings via internal oilings in the normal way. Falling to the base of the sump, the oil is returned to the tank by a dual scavenged pump. It is, of course, necessary to make provision for rapid return of the oil to the tank to prevent build-up of lubricant at the base of the engine, and it must also be remembered that oil produces more resistance than air to crankshaft webs rotating at high speed.

With dry sump lubrication, one of the main problems is to prevent seepage of the lubricant, and on the Jaguar engine this has been accomplished by baffles inside the oil tank, with a baffle plate from the top of the tank connected to the crankcase.

As with the production engine, a light alloy cylinder head is used, with valve seat inserts for both inlet and exhaust valves. It has hemispherical combustion chambers and inclined valves, and the engine operates on a compression ratio of 9:1. To aid installation, the engine is inclined in the chassis at an angle of 8° to the left when viewed from the cockpit. The barrels of the three double-choke Weber carburettors are set at a similar angle to the vertical centre line of the engine, so that they are truly horizontal when the unit is installed. Six
Both oil and coolant radiators are of light alloy and produced by Marston Excelsior. The radiator system is pressurized to 4ib per sq in by means of a valve unit mounted in the back of the tank.

A conventional fuel system is used, but an unusual feature is the use of flexible tanks, supported in light alloy boxes. To obtain the desired range between refuelling stages, two tanks are used. Twin petrol pumps, placed behind the rear diaphragm, connect to a common delivery pipe to the carburettors.

Power is transmitted from the engine via the triple-plate clutch to the four-speed synchronesh gear box. The main clutch body contains three sets of internal splines equally spaced around its bore, mating with the external splines on the two intermediate driving plates. The rear clutch driven plate is attached to a centre piece which is internally splined to mate with the gear box input shaft, and contains three sets of external splines carrying the first and second driven plates.

The pressure plate assembly, bolted to the rear, contains six springs together with the toggle levers, which are operated by the ball-bearing withdrawal mechanism. The actual clutch operation is hydraulic by a Girling unit. Radial holes are drilled in the clutch body, to assist cooling and allow fuming dust to escape. The complete clutch assembly is housed in a conventional bell housing, with the clutch driven plate driven by a take-up motor, which is above the transmission on the engine centre line.

Single helical gears are used in the gear box and special close ratios have been chosen. The gears are selected by a short change lever conveniently placed.

THE D-TYPE

With the bonnet open the engine and front suspension are very accessible. The oil tank is carried just behind the left front wheel, while the small battery is placed in a similar position behind the right wheel. The large pipe running from the oil tank between the two exhaust manifolds is a breather which is connected to the engine.
The D-type engine can be distinguished by the very shallow sump used in conjunction with the dry sump lubrication system. The torsional vibration damper can be seen at the front of the engine behind the dynamo and water pump driving bolts.

just aft of the gear box unit. A small, flexible breather pipe extends forward and upward to the front of the main bulkhead.

From the rear of the gear box, a short Hardy Spicer propeller shaft continues the drive to the Salisbury rear axle. Except for a change in ratio and modified length of the axle tubes, this unit is similar to that fitted in the production XK. It has a hypoid final drive with a ratio of 2.79 to 1 and, with the tyres with the wishbone. These two portions are concentric with the axis of the shaft, but the portions which pivot in the rubber bushes are eccentric, and the combined effect of the screw thread and eccentricity enables the wheel caster and camber to be adjusted after assembly.

With a number of torsion bar front suspensions, the bar supporting the weight of the car is concentric with the lower pivot point, but in the Jaguar layout, the front member of the lower wishbone assembly extends from its fulcrum point towards the centre of the car, forming a splined attachment for the bar which runs at an angle of 2½° to the centre line of the car. This enables the bar to be changed without disturbing the main suspension components, but it also means that the suspension characteristics are modified slightly by the combined effects of bending and torsion. To adjust the height of the car, a vernier arrangement of spindles is provided.

**Rack and Pinion Steering**

The steering arms, extending in front of the wheel centre line, are linked to the rack and pinion steering unit, which is placed fairly high in front of the main cross-member assembly. There is a universal joint in the steering column.

At the rear, the suspension consists of a live axle, trailing arms and a torsion bar. Two massive, box-section members attached to the main body structure provide bearing housings for the trailing-link units. The top links are 3½ in long and of flat steel plate of approximately 2½ in section. Rubber bushes are used for both the inner and the outer bearings. Metal bushes used for the lower bearings are 1½ in diameter, and are lubricated by grease nipples. Steel plates are also used for the lower links, and these have a similar centre distance to those above, so that a true parallelogram is formed. To provide attachment of the lower links to the torsion bars, bearing units are riveted to the inner ends of the lower links; these are also bored to provide clearance for the torsion bar, and contain a larger diameter outer ring which is internally splined. The ends of the torsion bar, also splined, are of a much smaller diameter, so that, to connect the torsion bar to the rear links, rings are used which are externally splined to mate with the lower links and internally splined to connect with the torsion bar.

The single torsion bar used for the rear suspension has an enlarged centre section which is attached to a reaction plate bolted to the centre of the main body structure and containing arms which pass on each

**JAGUAR . . . continued**

used at Le Mans, this gives a speed of 183 m.p.h. at 6,000 r.p.m. engine speed.

The front suspension is by upper and lower wishbones and longitudinal torsion bars. The lower wishbone bearings are in line with the longitudinal centre line of the chassis, and rubber bushes form both upper and lower bearings; the front bushes are conical, while the rear ones are parallel. The upper wishbone—a one-piece forging—contains the ball housing at its outer end to permit the required movement for suspension and steering, while at the inner end there are two split bosses with pinch bolts.

The front boss is threaded internally, while a smaller diameter, plain section is provided for the rear one, the shaft which forms the top wishbone inner fulcrum having screwed and plain portions to mate

How the tubular frame members are united with the rear diaphragm plate. To provide extra clearance for the driver, a small diameter tube is used in place of a large square section one for the top right-hand member.

To enable the rate of wear of the brake friction pads to be determined during a race, a small visual indicator is provided with a pointer which lines up with a series of marks engraved on one of the caliper housings.

To provide transverse location of the axle unit, an open A bracket is pivoted to the main structural members, the bearings being slightly forward of the link bearing line, while the apex of the A

side of the propeller-shaft. The effective length from the reaction point to the splines is 20 in. Under cornering conditions, the plates forming the suspension links in torsion, increasing the roll stiffness of the car and necessitating the use of material for the links which will permit some flexibility.

This sketch gives a diagrammatic representation of the main members which form the structure of the car; this car is in magnesium-alloy structure has been carefully stressed to provide maximum rigidity with very light weight.
Engine lubrication: A cross shaft, gear driven from the front end of the crankshaft, provides the drive for the pressure and scavenging pumps.

To transmit the drive a neat and compact triple plate clutch is used, and the two intermediate driving plates are splined into the centre portion of the clutch housing.

terminates in a bearing which is secured by a bracket to the axle tubes, serving not only to provide traverse location but also to determine the height of the rear roll centre.

The suspension is damped by CDR 4½-type Girling telescopic dampers. At the front these are attached to the upper section of the front cross member at the top and the lower wishbone at the bottom, while at the rear dampers are inclined transversely to clear the upper suspension links, the damper itself being attached to the lower link and bracketed to the main body structure. Built-in bump stops in the dampers consist of large rubber pads placed around the main damper spindle, which contact with the top of the main damper casing, while hydraulic rebound stops are also incorporated.

It was emphasized previously that one of the methods used to improve the performance of the new D-type car was to reduce wind resistance. When the drag of a car is reduced, so that it requires a relatively small b.h.p. to propel it at a high speed, it also requires extremely good brakes, since the retarding effect of air resistance has been reduced. As on last year's cars, Dunlop disc brakes are fitted to all four wheels. They have 12½in diameter discs and three pairs of pads are used at the front, and two at the rear, to provide the required braking distribution. All the pads are 2½in diameter, so that the total friction lining area for the foot brake is 45 sq in front and 30 sq in rear. To improve the brake life, the volume of the friction material has been increased by approximately 20 per cent since last year.

Structurally, the brakes consist of a caliper, machined from medium carbon steel, attached to a suitable flange on the front or rear suspension in the same way as the brake back plate is fixed on a drum-brake system. Bore is in this caliper provide housings for the brake pads—which are circular blocks of brake lining material—so that torque reaction is taken by the caliper housing.

To eliminate the effect of disc distortion which might arise through deflection of the rear axle half-shafts when cornering, the rear brake pads are placed symmetrically about the horizontal axis of the wheel centre line. The brake discs are of mild steel, which is hard-chromium plated to reduce the rate of wear.

**THE D-TYPE**

Under very arduous conditions, the temperature rise in and around the caliper area might cause the brake fluid to boil. To provide adequate cooling, the brake-operating cylinders—are for each group—twenty cylinders therefore, being required—are arranged in the form of light alloy blocks, attached to the calipers by bolts and distance pieces to provide adequate air space. The outer end of each piston has a spherical seating so that slight tilting of the brake pad does not produce severe side loading on the piston. A normal type of rubber diaphragm seal is fitted towards the outer end of the piston to prevent foreign matter from reaching the cylinder bores. Drillings in the light alloy block take the supply pipes, while nipples are provided at convenient points to enable the system to be bled.

**Automatic Adjustment**

It is necessary to reduce to a minimum the movement required to bring the brake pads into contact with the disc, but at the same time to ensure that the pads are not rubbing when the brakes are not applied. If an unnecessarily large clearance were provided between pad and disc there would be an excessively long pedal movement before the brakes came into operation, owing to the large number of operating cylinders that are employed in this system.

To overcome this difficulty an ingenious system of retraction and automatic adjustment is provided to maintain

The front torsion bars are attached to an extension on the front portion of the lower wishbone, which is continued in past the fulcrum point.
only 0.010 in to 0.015 in clearance between the pad and the disc when the brakes are in the off position.

To apply the brakes, a dual hydraulic system is provided, with servo assistance by a Plessey pump driven, from the back end of the gear box, whenever the propeller-shaft is rotating. A simple hydraulic layout is used to operate the front brakes which, if necessary, can be applied without assist from the servo, in the event of a failure occurring in the servo circuit.

With the servo in operation, the fluid is pumped from the header tank into the rear of the master cylinder, through four cross-drillings into the hollow centre of the master cylinder piston which applies the front brakes.

The layout of the pistons in the brake master cylinder is shown in the diagram. Although it is necessary for the driver's foot to close the valve which increases the line pressure, the area covered is much less than the area of the front brake master cylinder piston, and it is this difference which determines the servo ratio.

As the servo pump is driven from the output side of the propeller-shaft, it will be rotated in reverse whenever the engine is backwound, and, unless precautions were taken, this might cause air to be drawn into the system. A valve box is fitted between the input and output pipes from the pump. A return valve is placed so that pressure in the suction side of the pump causes the valve to close the output, thus providing a short open circuit between inlet and outlet sides of the pump. Two separate sets of mechanically operated calipers with triangular friction linings, fitted below the main hydraulically operated units on the rear brakes, are operated by a single cable connected to the handbrake lever by a pulley compensating mechanism.

To reduce weight, perforated disc light alloy wheels are used. Top speed, 90 mph; maximum speed, 100 mph; aerofoil wheels are used. A centre-locking fitting is provided in the nose of the splined hub, and the wheel is adjustable and held on by a screwed clamp. In true racing tradition it has light alloy disc, with a wooden rim.

The curved plastic windscreen sweeps well round the sides of the cockpit, and the rear part of the body has a head rest just in front of the fuel filler cap and, to improve the direction stability under adverse wind conditions, particularly at speeds over 150 m.p.h., a tall fin which neatly blends into the driver's head rest.

**SPECIFICATION**

**Engine**—6-cyl., 83 x 106 mm., 3,442 c.c.

**Compression ratio** 9 to 1.

**Maximum torque** 242 lb. ft. at 4,000 r.p.m.

**Weight** 1,500 lbs.

**Suspension**—Front: independent, wishbone and torsion bar. Rear: trailing link and torsion bar. Suspension rate (at the wheel) front, 150 lb. per in.; rear, 120 lb. per in.

**Brakes**—Dunlop disc. Three-pedal front; two-pedal rear. Discs: front 12 in. diameter, rear 12 in. diameter. Total lining area: 75 sq. in. at 45 sq. in. front.

**Steering**—Rack and pinion. Eight-toothed pinion. 1 lever turns from lock to lock.

**Wheels and Tyres**—Dunlop light alloy, perforated disc, centre-lock wheels, 19 x 16 in. Dunlop racing tyres on 5.00-16 in. rims.

**Electrical Equipment**—12-volt; 40-ampere-hour battery. Head lamps, 40- or 60-watt bulbs.

**Fuel and Oil System**—33 Imp. gallons in two flexible tanks. Oil capacity 3 Imp. gallons.

**Main Dimensions**—Wheelbase 7½ ft.; track (front) 4 ft. 2½ in.; (rear) 4 ft. Overall length 12 ft. 10 in. Width 5 ft. 5½ in. Height at scuttle, 2 ft. 6½ in. at fin, 3 ft. 8 in. Ground clearance 5½ in. under sump. Frontal area 10.35 sq. ft. Turning circle 32 ft.

The fuel is carried in two flexible tanks, which are neatly fitted into light alloy boxes in the tail of the car.

The starter ring is attached to the centre of the clutch casing; no normal flywheel is used; the necessary flywheel effect being obtained by the mass of the clutch and ring.