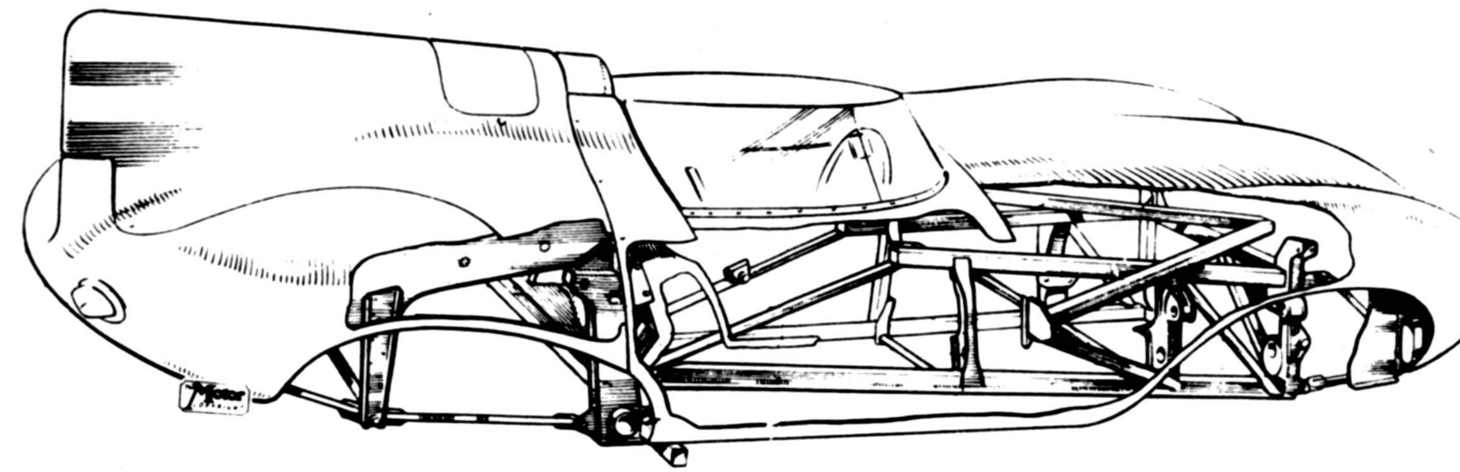
When it comes to a fast, flat circuit the D-Type Jaguar is the car to beat. On tight U.S. circuits, modifications are in order. Here is the story.



Steel is used for the production D-Type frame, which can be detached from the cockpit unit.

Drawing courtesy The Motor, England

SCI Technical Report: the hottest jaguar

By KARL LUDVIGSEN

AFTER its postwar resumption in 1949, the 24-hour race at Le Mans has grown in stature annually, and among the first to realize its great publicity value was Jaguar Cars, Ltd. The fast-growing English firm has fielded by far the most successful team at Le Mans since the war, having won every other year since 1951. All their efforts have been concentrated on this classic, and entries in other races have been at best token efforts. Naturally and without question, the Jaguar competition cars are "Le Mans cars," perfectly suited to the fast, flat Sarthe circuit.

Though restricted in its original intent to the Le Mans type circuits, the D-Type Jag has been proven to be a car to beat on many courses. Production versions are now being distributed to individuals and racing stables, and certain faults are coming to light and being corrected, as we will see here.

From the body design standpoint, Reid Railton's 1938 design for the late John Cobb's land speed record car is the initial inspiration for the D-Type. Railton knew that many very fast cars were particularly sensitive to side winds at speed, and that designers had tried to move the center of pressure back by using fins. These early cars, though, were slab-sided as barns, and presented a lot of resistance to a lateral breeze. Railton took the cue and came up with a car that was aerodynamically clean from *all* directions, and sat flat at 400 mph with no finning.

In the U.S., Lee Chapel and Harold Post followed up with similar contours for Bonneville streamliners; another internationally significant design was the "Disco Volante," produced by collaboration between Alfa Romeo and Touring. These startling cars were introduced in June of 1952, and produced much more publicity than race wins. Jaguar saw the light, though, and by June of 1953 they had a prototype body ready for the C-Type that embodied the same basic streamlined ovoid-form-plus-wheel-bulges that the above cars had, and was clearly the daddy of the D.

Jag raced the older C body at Le Mans in '53, but they took the prototype C to the Jabbeke Highway in October of that year, and cranked it up to 178.383 mph with a basic M-Type engine. Development continued, and early May of 1954 found that C prototype (now fuel-injected) and a brand-new D Type on trial at Le Mans. Rolt circulated in the unpainted D some 2¼ mph faster than Ascari's 1953 4.5 Ferrari record, but at the end of the race itself he and Hamilton were 2.54 miles down on the rapid new 4.9 Ferrari. A later win in the Rheims 12-Hour made up for this.

The 1954 D-Types were true prototypes, and differed from the present production D in several respects. After a review of these differences, we can get on to a study of the present production car.

Frame construction was the main variation. Then, as now, the central cockpit was an oval-sectioned monocoque

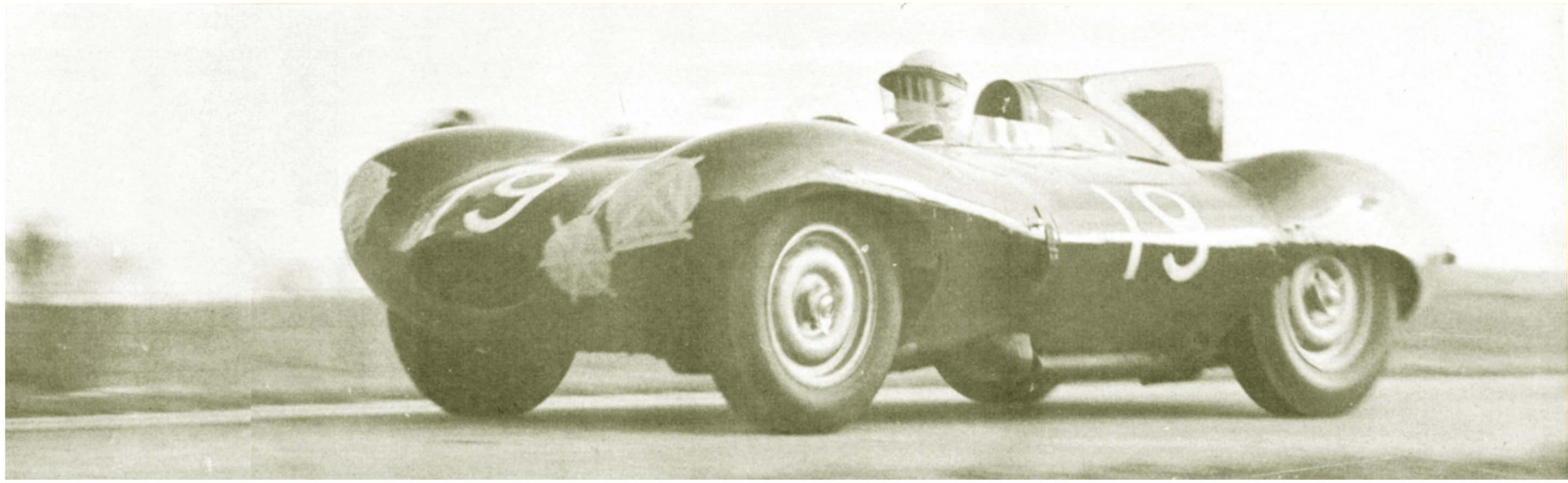
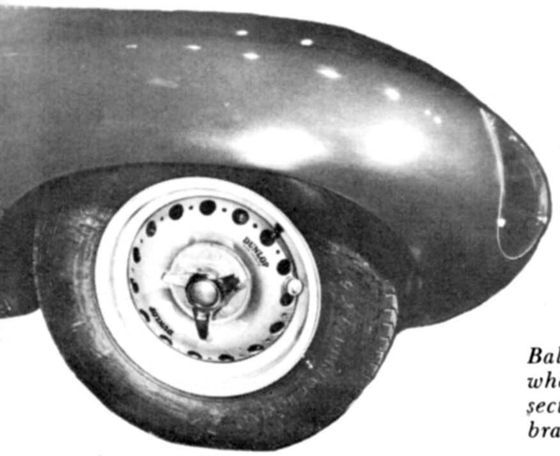


Photo by Dan Rubin



Balanced by bolt-on weights, the alloy wheels are reinforced by steel center sections. Dunlop-made wheels, tires and brakes are shrouded by contoured fender.

SPECIFICATIONS D-TYPE JAGUAR

PRICE .... $10,000 (out the door, incl. tax and license).

ENGINE

Cylinders .... 6, in line
Bore and stroke .... 3.27 in x 4.12 in (83 mm x 106 mm)
Capacity .... 210 cu in (3442 cc)
Piston area .... 50.4 sq ins
Firing order .... 1, 5, 3, 6, 2, 4 (1 at rear)
Compression ratio .... 9 to 1

Output	*Production*	*Le Mans*
Max. horsepower	250 @ 6000	285 @ 5750
Max. torque	242 @ 4000	264 @ 5500
Max. b.m.e.p.	174 psi	190 psi

Valves	*Inlet*	*Exhaust*
Head dia.	$1\frac{7}{8}$″	$1\frac{5}{8}$″
Stem dia.	$\frac{5}{16}$″	$\frac{5}{16}$″
Seat angle	30°	45°
Clearance	.006-.008	.010-.012

Carburetors .... 3 Weber 45 DC03
Ignition
Breaker gap .... .012-.014
Timing .... 8° BTDC
Plugs
Road .... Champion NA8
Racing .... Champion NA10
Gap .... .022
Oil capacity .... $33\frac{1}{2}$ pints
Water Capacity .... $34\frac{3}{4}$ pints

CLUTCH .... Borg and Beck $7\frac{1}{2}$″ dia. triple plate

GEARBOX

Ratios
4th .... 1 : 1
3rd .... 1.28 : 1
2nd .... 1.645 : 1
1st .... 2.144 : 1
Rev .... 2.194 : 1
Oil capacity .... 3 pints

REAR AXLE	2.93	3.31	3.54	3.92
Speeds in gears				
4th	169	146	138	125
3rd	130	115	108	95
2nd	102	90	84	75
1st	77	68	67	58

1955 Le Mans ratio 2.53
Other available ratios 2.79, 4.09, 4.27, 4.55
Oil capacity .... $4\frac{1}{2}$ pints

WHEELS .... 16 x $5\frac{1}{2}$K Dunlop light alloy disc

TIRES

	Front	*Rear*
Up to 140 mph	600 x 16, 32 psi	650 x 16, 35 psi
150 to 170 mph	650 x 16, 45 psi	650 x 16, 50 psi

BRAKES

Disc dia. .... $12\frac{3}{4}$ ins.
Pad dia. .... $2\frac{3}{16}$ ins.
Lining area
Front .... 45 sq in.
Rear .... 30 sq in.

STEERING

Type .... Rack and 8-tooth pinion
Turns lock to lock .... $1\frac{3}{4}$
Turning circle .... 35 ft
Steering wheel .... 16 in dia. light alloy

SUSPENSION

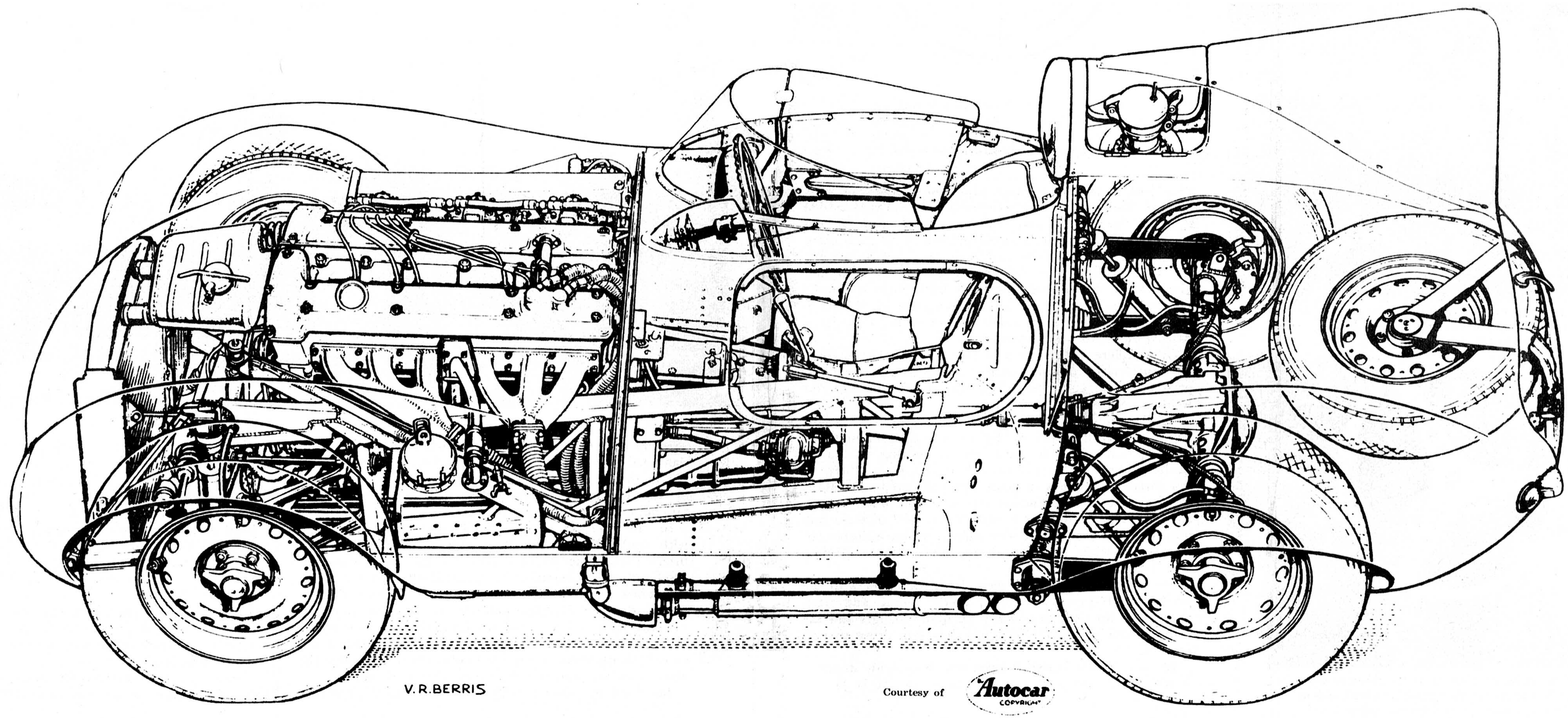
Overall rate, front and rear .... 120 lb/in
Shock absorbers .... Girling CDR $4\frac{1}{2}$ tubular

CHASSIS

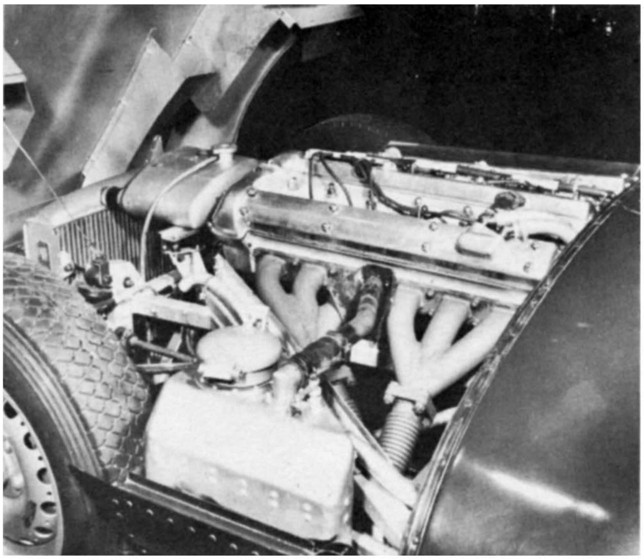
Wheelbase .... $90\frac{5}{8}$ ins
Front track .... 50 ins
Rear track .... 48 ins
Toe in .... 0-$\frac{1}{16}$ in
Caster .... $3\frac{1}{2}° \pm \frac{1}{4}°$
Camber .... $1\frac{3}{4}° \pm \frac{1}{4}°$

OVERALL

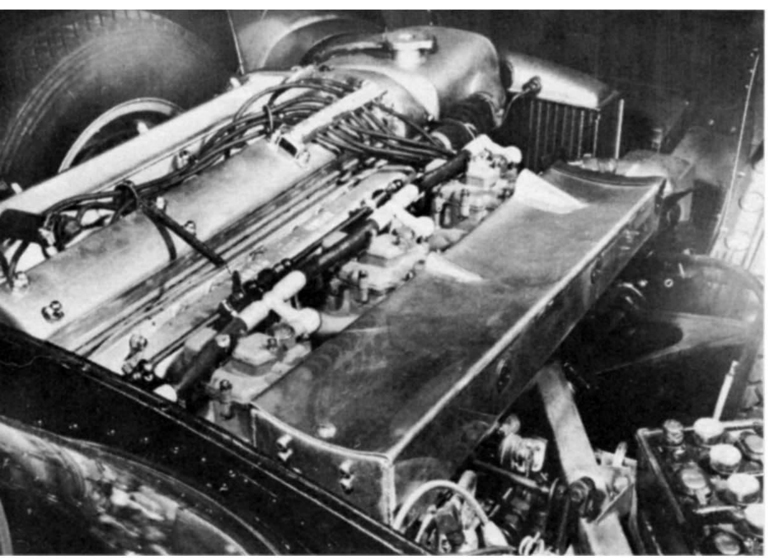
Length .... 154 ins
Width .... $65\frac{3}{8}$ ins
Cowl height .... 32 ins
Fin height .... 45 ins
Ground clearance .... $5\frac{1}{4}$ ins
Frontal area .... 10.85 sq ft
Fuel capacity .... $43\frac{3}{4}$ gal
Dry weight .... approx. 1940 lb



THE D TYPE JAGUAR

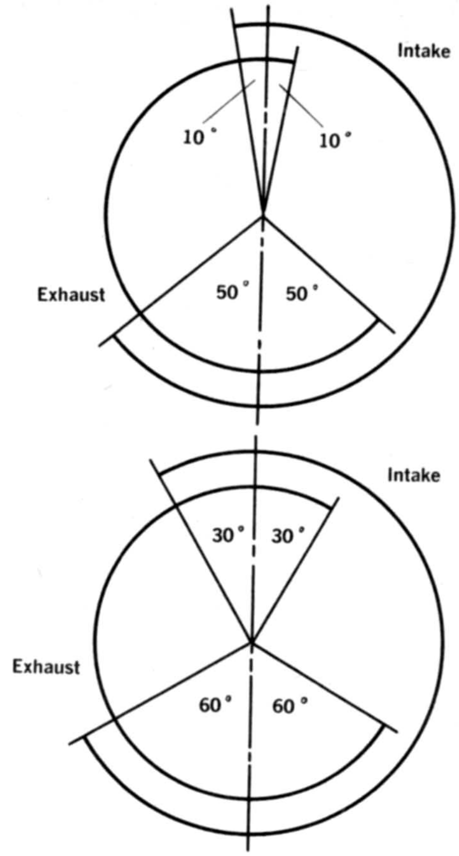


Crankcase breather, ducted to oil tank, is shielded from exhaust heat. Wiring and other breathers have flexible armor.



Engine inclination was necessary to provide room for carburetors and cold air box. Weber carbs receive fuel in series.

Production cockpit has more elbow room, thanks to frame changes. Horn button is at right of wood-rimmed wheel, "glove box."



Upper diagram shows valve timing for stock Jaguar; duration is 240 degrees. Lower diagram illustrates the hotter timing and 270 degree duration of D.

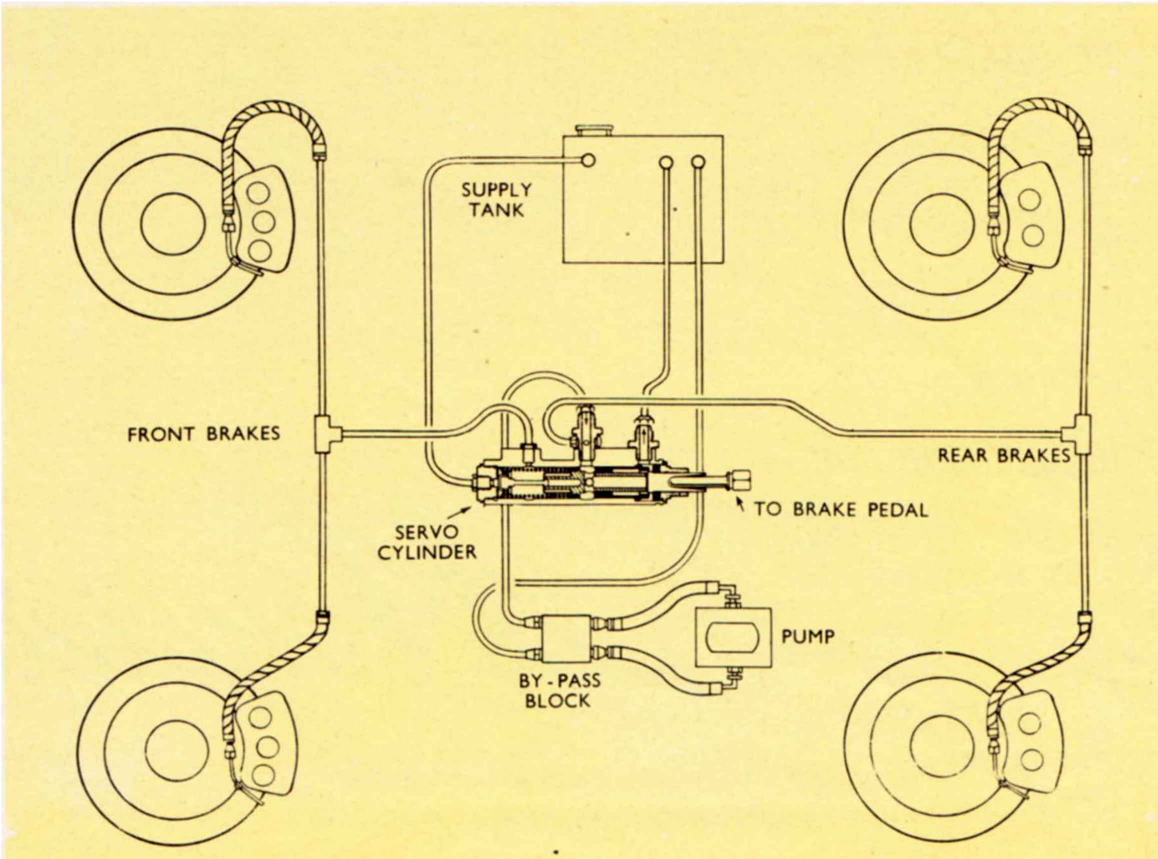
unit, with a riveted 18-gauge aluminum-magnesium alloy stressed skin. In the 1954 car, though, the forward tubing structure for engine and front suspension support was made of a similar alloy, argon arc-welded to each other and to the cockpit. This was costly and time-consuming, and made repairs very difficult, as Colin Chapman also discovered with his prototype Mark VIII Lotus. Similarly, the radiators were borne by an extension of the main frame, and certain tubes in the center of the cockpit restricted the driver's elbow action.

Other differences include a non-synchromesh-low gearbox, an unnecessarily complex cooling system header tank and pressure valve, and lateral locating arms bolted and not welded to the rear axle tubes.

By the approach of 1955, the production version was taking shape, but not by any means soon enough for Briggs Cunningham to have one at Sebring in March. Walters and Hawthorn drove a 1954 factory car there, as did Duncan Hamilton in many European events. Le Mans 1955 saw the first production cars in action, but with certain additional prototype modifications. One of these cars duly won the race, but under admittedly inconclusive circumstances, while Hawthorn drove lone entries at Aintree and the Tourist Trophy.

For the main discussion, then, I will deal first with the production D-Type as available to the public, and afterwards take up both the factory Le Mans changes and the Cunningham car which Sherwood Johnston drove so well in 1955.

In spite of substantial changes, the chassis-body structure is still by far the most unusual feature of the D Jaguar.



The central oval cockpit section has holes in the top for the driver and the passenger hatch, and has full bulkheads at front and rear. These are pierced only by the driveshaft in the rear, and the gearbox and driver's feet in the front. Inverted L-shaped boxes are riveted low on each side of the interior, adding greatly to the stiffness of this very light fully-stressed cockpit.

The prototype alloy tubing has given way to 18 and 20 gauge square-section steel tubing, brazed together. This new subframe weighed slightly less than the original, thanks largely to considerable simplification in the cockpit region. Flanged on the bottom to support the floor, the two main tubes sprout from the driveshaft hole in the rear bulkhead and diverge to the lower front suspension mounts. Starting from the same rear point, the upper tubes rise sharply in small section to the front bulkhead, where they enlarge, level out, and diverge similarly to the upper front wishbone mounts. Vertical and lateral bracing at this point unites and stiffens the front end, while two additional large tubes begin at the maximum width of the front bulkhead and converge to a point just behind the radiators. A detachable frame of circular-section tubes carries the oil and water radiators and the hood pivots, while the tubular frame as a whole is merely bolted to the stressed cockpit at the front and rear bulkheads and along the floor, greatly easing repairs.

Four main bolts and an additional series across the top suspend the riveted alloy tail from the rear bulkhead. The tail must support only its own weight and that of the spare

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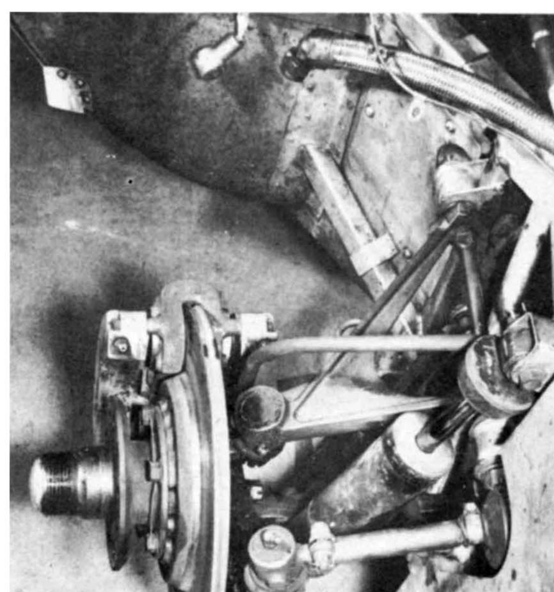

Brakes on Cunningham D-Type have wheel scoops in addition to nose ducting. Wishbones are forged.

The hottest Jaguar

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wheel, fuel and tank, and this it does by stressed internal diaphragms instead of a framework as on the prototype. Two horizontal struts below the axle add support in compression. The fuel tank itself is flexible, of "rubberized" fabric, and is housed in an alloy box in the tail.

With the tail removed the D-Type looks odd indeed, since the live axle is suspended directly from the rear bulkhead. Two flat steel trailing arms 16 inches long form a parallelogram on each side, absorbing braking and accelerating torque reactions as well as providing fore-and-aft axle location. The upper arms are simply rubber bushed, while the forward pivots of the bottom arms engage the extremities of a transverse torsion bar through internally-and-externally splined vernier couplings. An enlarged center section of the bar is splined to its surrounding tube, giving, in effect, a separate torsion bar for each wheel. Lateral axle location is looked after by a large A member, with its spex fixing the rear roll center at the differential casing.

The forward ends of the four trailing arms and the pivots of the A member are located on two vertical fabricated posts which are connected at the bottom by the torsion bar housing and the top by a smaller tube. Cirling shocks with built-in bump stops also act from these posts, which in turn are bolted to boxed stiffeners in the rear bulkhead. In action, geometry requires the trailing arms to twist slightly, and their flat section allows this and provides additional roll stiffness.

Praise is due the very neat front suspension, which is one of the cleanest parts of the D Jaguar. Of the well-known parallel wishbone type, it also uses the ball joints that are now common on both sides of the Atlantic. The wishbones themselves are beautifully forged, and the slightly shorter top arm has eccentric and threaded pivots at the frame to allow adjustment of caster and camber. Simple pivots are used for the lower arm, and from them the forward leg of the wishbone extends inward far enough to provide a splined mounting for the forward end of the longitudinal torsion bar, which is not, then, concentric with the bottom arm pivots, and is thus subject to very slight bending. Twenty-four splines at the forward end and 25 at the frame connection allow a vernier adjustment of height.

An anti-roll bar is now fitted at the front, and Girling shock absorbers again do the job, acting on the lower wishbones. Steering is by rack and pinion, the box sitting high and controlling the wheels by links and arms forward of the wheel center. The steering column is in two sections, with two universal joints in the control shaft.

Also in the chassis department and also unusual are the Dunlop wheels and brakes. That "Indianapolis" look is caused by the pierced aluminum-alloy wheels, which carry a steel center section and five bolts, the domed heads of which engage with holes in a hub

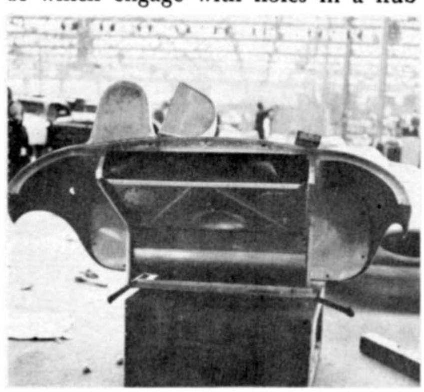

plate and thus transmit braking and drive torque. These increasingly-popular discs are lighter than the equivalent wire type, and are retained by three-lobe locking nuts.

Design of Dunlop disc brakes for competition has reached an initial stage of stability, but many aspects of service are still left to the discretion of the owner. The basic layout first distributes braking effort by providing three pairs of pads for each front disc, and two pairs per wheel at the rear. In the Dunlop system, each pad has its own small hydraulic cylinder, and these are bored in appropriate groups in light alloy blocks, which are separated from the pad-bearing calipers by pylons. Air can thus pass between the pad and the piston, and can keep the hydraulic fluid at a reasonable temperature. Clearance is automatically held around 0.010 of an inch, and 13/16 of an inch of wear are allowed before new pads must be cemented to their carriers. When they have "dished" much more than 0.020, the discs themselves should be replaced.

Additional proportioning of braking force is effected by the clever and simple servo system. The front section of the servo cylinder is basically an ordinary master cylinder, applying the front brakes only. Behind the piston of this cylinder, fluid is kept continually circulating by a Plessey pump driven from the rear of the gearbox. A take-off from the inlet of this circulating system leads directly to the rear brakes. When the pedal is pressed, the forward piston immediately actuates the front brakes manually, and a rear piston begins to restrict the outlet of the circulating fluid. Pressure is thus built up, which supplements the effort on the front piston and applies the back brakes directly. The degree of restriction can be varied to modify the servo effect.

Front and rear systems are thus hydraulically separate, and the front pads will always be applied if the pressure pump is inoperative. A by-pass valve prevents air from being drawn into the system when the car is backing up, and additional mechanical calipers at the rear provide hand braking. The whole servo system is, of course, necessary to avoid excessive pedal travel as a result of feeding twenty wheel cylinders, as well as to make up for the lack of servo in a disc system.

"XK" has been the password at Coventry for seven years, and it still applies to the production D-type engine. The cast iron block, the forged steel connecting rods, and the forged EN-16 steel crankshaft differ only in minor machining from Mark VII parts, while the head is a modified aluminum alloy C-type casting. Vandervell indium-lead-bronze bearings carry the seven main and six rod journals, which are 2.750 and 2.086 of an inch in diameter respectively. The crank is not fully counterweighted, the feeling being that torsional vibration would be more of a problem than bearing loads, and to the same end a large steel vibration damper is fitted at the front. This plus the mass of the special clutch eliminates the need for a separate flywheel.

The two-bolt H-section connecting rod is drilled to lubricate the fully-floating wrist pin, which is held in the full-skirted Aerolite piston by circlips.

A special Dykes design for the centrifugally-cast top rings greatly reduces blow-by at high piston speeds, and a single Maxilite oil control ring is used. Recommended skirt clearance is .006 of an inch, which could probably be almost doubled for shorter races, or for use with hot fuel.

A two-stage Renold duplex roller chain, controlled by a Weller spring tensioner, drives the twin overhead camshafts, which in turn operate the valves through cups sliding in inserted cast iron guides. The cam contours retain the 3/8 lift of the M and C cams, but increase intake duration by 30°, to a total of 270°. Still larger than in older versions, the valves are symmetrically placed with an included angle of 70°, and returned to their seats by double springs. These changes, aided by a 1/2-point compression ratio increase to 9 to 1, have brought the power up 30 bhp from the 220 bhp C-Type.

Basic porting has not changed from the original Weslake layout, the intake passage being slightly curved to provide turbulence. The spark plug is at one side of the hemispherical chamber, in such a position as to produce a flame front moving away from the intake valve. So much room is taken up by the three twin-choke Weber carburetors and their associated plumbing that the engine is canted 8½ degrees to the left on its three-point mounting to allow space at the top. Giving a 45 mm bore and 38 mm choke for each cylinder, the type 45 DC03 Webers supply very accurate mixtures at high lateral G's, thanks to the centrally-disposed emulsion

tubes and jets. Short velocity stacks draw air from a grille-supplied balance box, and fuel arrives via a single flexible line from the two S.U. pumps on the rear bulkhead.

Two three-branch welded exhaust manifolds feed first short flex pipes and then the outside sections, which end just before the rear wheel. Ignition is thoroughly conventional, being by a Lucas single-breaker automatic advance distributor, with a chassis-mounted Lucas HV12 coil.

Partly to facilitate oil cooling, but mainly to reduce engine height by 2¾", a dry-sump oil system is used. A transverse shaft at the front of the engine is gear-driven from the crankshaft, and powers the scavenge pump on the left and the pressure pump on the right. The steel drive gear of the scavenge pump engages with two cast iron idlers, to facilitate the use of two separate oil pickups at front and rear of the shallow sump. This pump attempts to fill the three gallon oil tank, which rests on the left and is vented to the crankcase. The single-idler pressure pump, however, draws from the tank and sends SAE 30 oil at 45/50 psi through the oil cooler and back to a transfer block which then supplies the main gallery. Owners are cautioned to change oil before every race!

Front-end space is shared by the vertical oil radiator and the Marston light-alloy water matrix, which is connected to the separate header tank by two hoses. The tank in turn gets hot water from a gallery cast into the intake "manifold." A pressure valve on the header tank keeps the system under a pressure of around 4 psi, and the operating temperature should be about 70°C.

As mentioned before the D Jag has no flywheel as such, and the pinion of the gearbox-mounted starter engages a ring gear on the clutch body itself. The two metallic driving discs are splined to the outside body, and of the three friction-faced driven discs, two are internally splined to the hub of the third disc, which is splined to the gearbox clutch shaft. A Girling hydraulic unit overcomes the force of six springs and small centrifugal weights to disengage the discs. This type of clutch, while tending to be rough, has favorably small unit and centrifugal loadings.

A wholly new transmission has synchromesh on all four of the helical, constant-mesh gears, and the lowly spur gear survives only in reverse. SAE 30 also is used here, and is a mainshaft eccentric. The short Hardy Spicer drive shaft has a sliding spline and two Hooke-type universal joints.

Another "like-standard" part is the Salisbury differential housing, which carries the hypoid final drive gears. Jaguar recommends that a separate housing be used for each ratio contemplated for competition, to save wear on the tapped holes, and also point out that dimensionally different housings are necessary for ratios above 3.54 and below 3.92. SAE 90 hypoid oil keeps things turning smoothly.

The D-type driver is faced by a 180 mph speedometer and a tach red-lined at 5800 and driven from the left-hand camshaft. He also knows oil pressure and water temperature but not oil temperature. The interior on the whole is very well finished, and all fuses and junction boxes are readily reached on the passenger's side. No full belly pan is fitted, the engine and drive line being exposed underneath for accessibility and cooling. Oddly enough, the engine must be lowered out of the chassis, and does not just lift out the top.

The production D-Type as outlined above is right on a par with the 1954 prototypes and is thus a hot machine in its own right, but Bill Haynes at Jaguar realized that something hotter under the hood would be needed to deal with the SLR Mercedes, so some significant modifications were fitted to the factory cars only in 1955.

Most important was an entirely new head casting, which breathed so well that more power was realized at lower revs, and the peak torque speed raised by 1000 rpm. In the new head, also developed by Harry Weslake, the inlet valve remains inclined at 35° to the vertical, but the exhaust stem now leans out at 40°. Identifiable by a square instead of a circular front inspection plate, the new design did not give complete satisfaction at Le Mans, so the factory decided not to release it quite yet. As a result, little is known about it, but it obviously has longer velocity stacks and almost certainly has much wilder cams and larger, straighter ports. A further refinement is the use of long double exhaust pipes intended to derive an extractor effect from a low pressure area at the rear.

Body changes were also in order, to improve already fine streamlining and give better driver protection. To these ends the nose was lengthened 7½ inches and fitted with brake cooling ducts, while the windshield was raised and faired back into a higher and cleaner fin. After some prolonged pit stops in 1954, an exceptionally large fuel filter was fitted in the cockpits of the 1955 team cars.

Briggs Cunningham's Le Mans Jaguar was privately owned, and as such could not use the prototype head that was allowed the factory machines. His car therefore was a production car in all respects save the nose and tail, which gave it the "team car" look. Once in this country, the D proved very difficult to handle on characteristically tight American courses. Excessive understeer (for Le Mans stability) made it tough to haul around corners, so the Cunningham team went to work.

They fitted soft, sticky Pirelli tires in the front, and harder Firestones in the rear, also cutting the front tire section to 5.50. More interesting, they con-

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Jaguar

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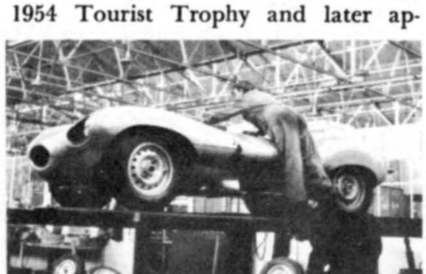
nected the two bottom rear trailing arms with a torsion anti-rolling bar, sensibly decreasing the rear cornering power. Both at Nassau and Palm Springs D-Types have suffered from lateral stabilizer failure, a weak point shown up by much more strenuous U. S. cornering conditions.

Short courses are also hard on brakes, and a disc can't dissipate heat without an air supply, so the front ducts are supplemented by 1954-type scoops. New ducting clamped to the axle tubes also picks up air from beneath the car and directs it on the leading edge of the rear discs. Just in case, a radiator blind is fitted that pulls down from the top window-shade-fashion and can be controlled from the cockpit.

Johnston didn't go over 6300 rmp at Nassau, and yet managed to break up the front connecting rod. On the other hand, Moss ran his engine up to 7200 in the '54 Le Mans, probably on the overrun when suffering from bad brakes, and didn't bust anything. The factory recommends that speeds above 5750 rpm be held for short periods only, and that upshifts be made at 5500. Gearing should allow the D to reach but not exceed 5800 on the straights. 5750 rpm move the pistons at 4000 feet per minute, which is a reasonable limit for the present-day engine, and exceptional for a ten-year old concept.

Attempts at prediction are always risky, but if Jaguar enters the 1956 Le Mans under the announced prototype rules, they might do well by adding long-awaited fuel injection to the 2.5 litre block that was tried in the 1954 Tourist Trophy and later ap-

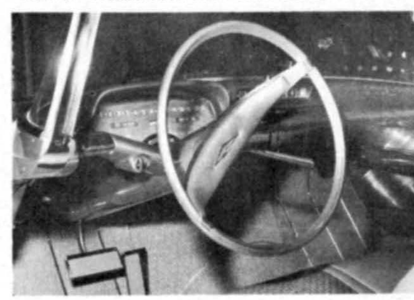


peared in the "2.4" sedan. Such a combo would be good for 100 bhp per litre anyway, and should wind up like a buzz saw. The great value of the Jaguar standard line is in no small way related to the lessons learned from such fabulously fast road machines as the hottest Jag: the D-Type. #

Chevies

(Continued from page 17)

already in volume production and not for the Corvette alone. This is a very hefty plant with a claimed 225 horsepower, peaking out at 5200 rpm which is probably the highest peak speed in the industry with only one exception. Torque also comes in at a fairly high 3600 rpm with a rating of 270 lbs/ft. These high rpm figures account in part for the seeming fact that Chevrolet's horses appear more powerful than those developed by other engines. Carburetion is provided by two four-throat units, one of which opens ahead of the other to prevent over-carburetion. Compression ratio is 9.25 to 1, a squeeze which points definitely to the use of premium fuel as S.O.P. One of the biggest extra-power items in the engine, however, is a camshaft that literally screams "full race" when the characteristics become known. Lift is .404 of an inch at the intake valve and .413 of an inch at the exhaust valve. Duration for the intake is 264



degrees and for the exhaust 266 degrees. Valve acceleration or rate of lift is also quite high for a Detroit product. Despite these characteristics idle speed is reasonably low and there is very little lope even at engine speeds as low as 600 rpm.

In view of Chevrolet's past performance in producing some version of each dream car (with the exception of the Biscayne and Corvair) coupled with the practicality of the Impala design it seems quite possible that the new coupe may very well see the street in the not so distant future. The Chevrolet people are, of course, quite cagey on the subject and point out that the car is, after all, a show car—but they haven't denied thinking very seriously about it either. One thing is certain—if produced, the Impala could be a sure seller and would be very rough competition indeed for certain of the more glamorous products of rival manufacturers. #