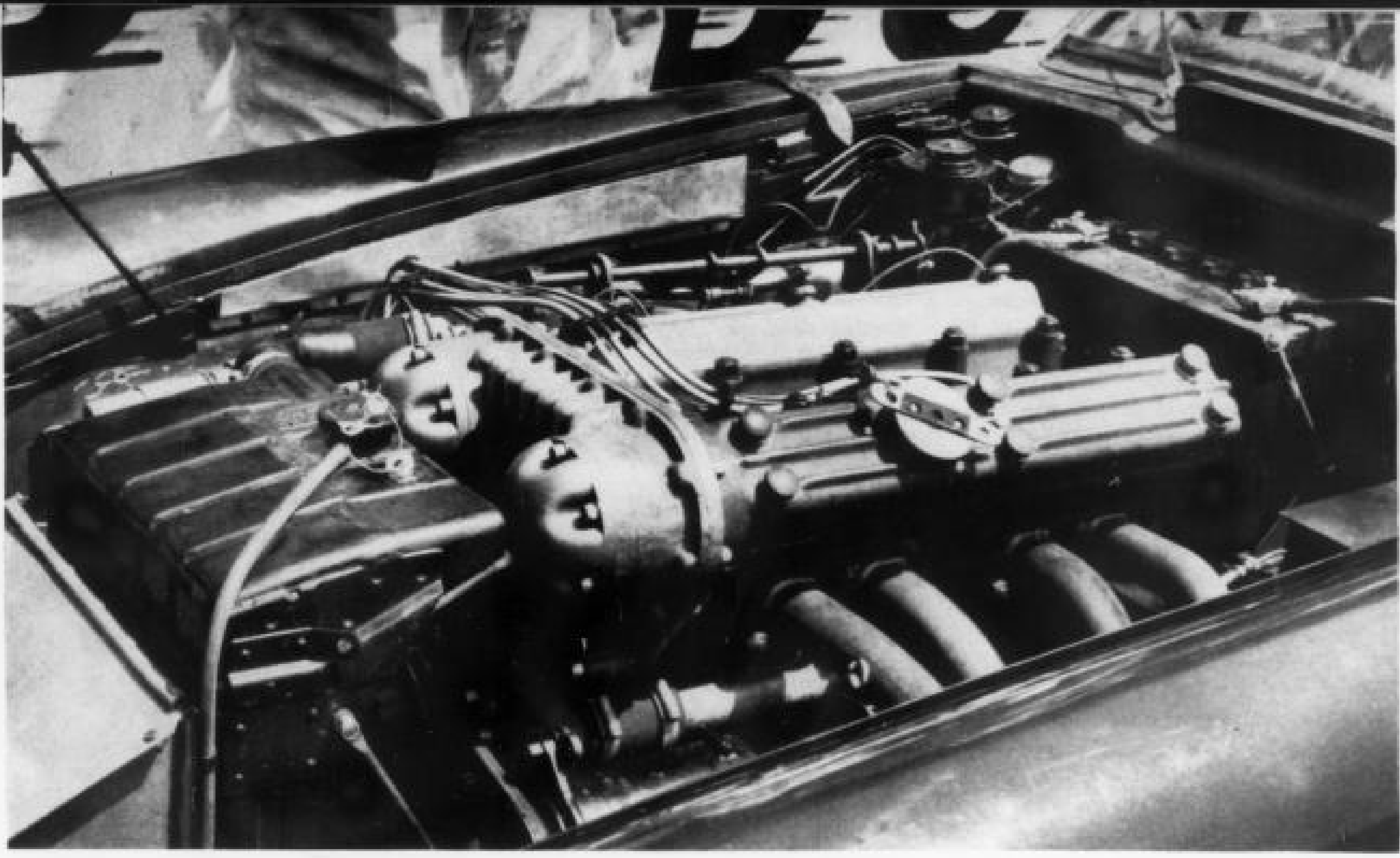


TRIUMPH'S TWIN-CAM!

by Dennis May

Racing proves a dramatic showcase for a new experimental engine, here described for the first time.

► In 1959, just a quarter-century after Triumph's first flirtation with dual overhead camshafts (remember the straight-eight Dolomite?), the prewar firm's successors quickened the pulses of the *cognoscenti* by entering a three-piece suite of d.o.h.c. cars at Le Mans. This Sarthe sortie, followed by another and more successful one last year, fermented worldwide curiosity in the breasts of TR fanciers. What, in detail, made the twin-cam engine tick? And when, if ever, would production facsimiles of it become available?

The answer to Question One unfolds hereunder, distilled from information gleaned during friendly discussions with Triumph engineers at the Coventry factory. To Question Two there still isn't an answer. Mr. Harry Webster, director and general manager of Standard-Triumph Engineering Ltd., describes the TR3-S power plant as "purely an engineering exercise in designing for easy production", and no plans at present exist for its translation into marketable merchandise. Confirming this, its external dimensions make its installation in the normal TR virtually impossible. So if you scent an apparent ambiguity in the fact that the unit has been designed and is being developed with far closer regard to labor and material costs than ultimate performance, we can only refer you back to that noun "exercise."

STRUCTURAL SANDWICH

The engine is built up in the form of a five-decker sandwich, its elements, reading from the bottom upwards, being: a) oil pan (capacity 12½ U.S. quarts); b) crankcase extension; c) crankcase; d) water jacket, housing four centrifugally cast chrome-iron liners which are in direct contact with the coolant; e) cylinder head. Uniting the head, jacket and

The TR trio at Le Mans, with restyled bodies and the twin-cam engine, hit 129 on the Mulsanne straight and finished intact in the 1960 24-hour race.

crankcase are five pairs of ½-inch studs, and five plain bearings support the crankshaft. This is a steel forging, balanced statically and dynamically, and has no vibration damper.

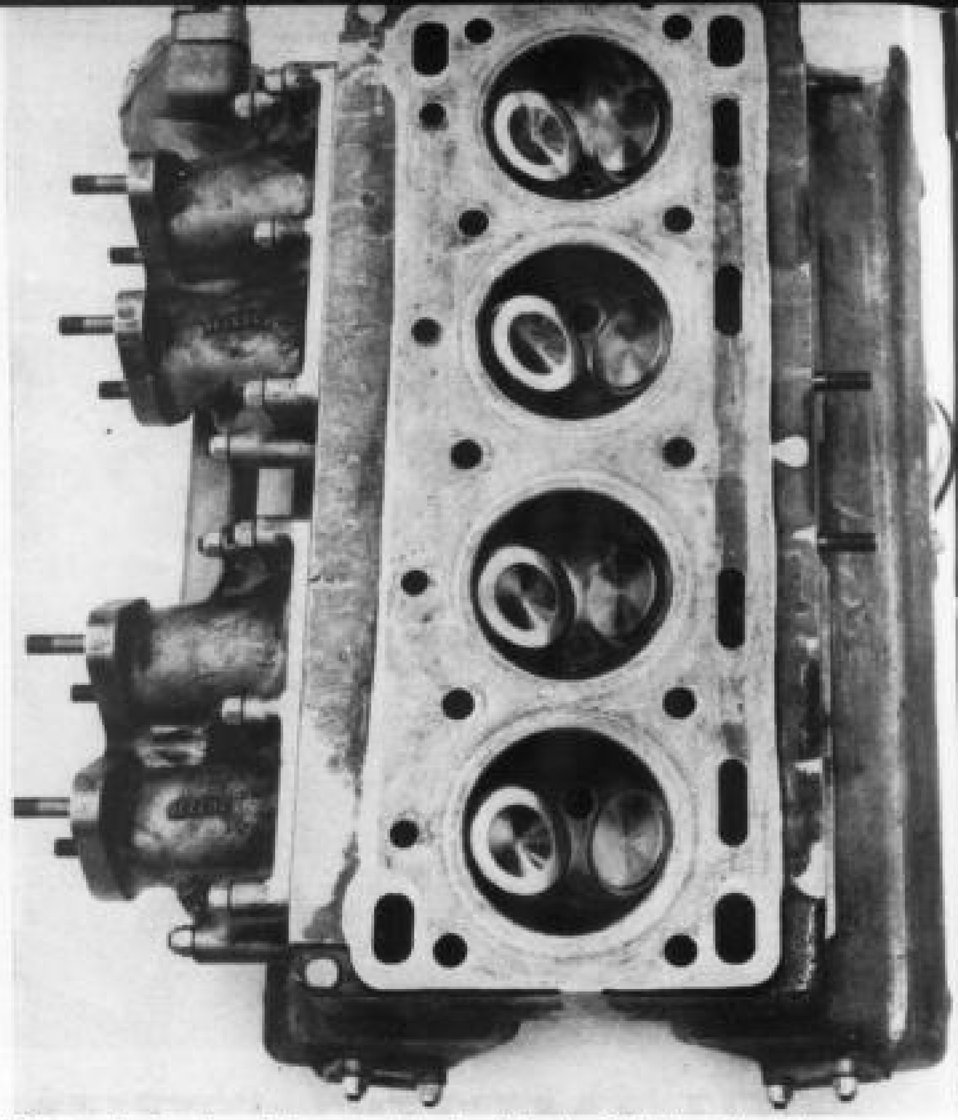
The cylinder head, water jacket, crankcase extension and pan are aluminum alloy castings, whereas the crankcase is cast iron. The 'S' engine, it's relevant to mention, has been subject to sundry variations at different stages of its life, data given here relating, unless otherwise stated, to the 1960 Le Mans version. Crankcase development is still in progress; alloy cases have been tried, some of them proving deficient in bending stiffness.

Crankshaft dimensions typify the all-around robustness of the engine, which is designed to withstand heavy duty over prolonged inter-overhaul periods. Main journal diameters are 2⅝ inches, with widths of 1⅜ inches for the front/rear pair, 1⅛ inches for the two intermediates, 1 11/16 inches at center. Forged conrods, with lower and upper bosses merged nicely into shanks with a minimum width of ¾ inch, run on crank- and wristpins with respective diameters of 2⅛ inches and 1 inch. The big ends are split at right angles to the rod axis and are 1⅛ inches wide. Mains and big ends both have steel-backed lead-indium-bronze bearings.

ALLOYS AND INSERTS

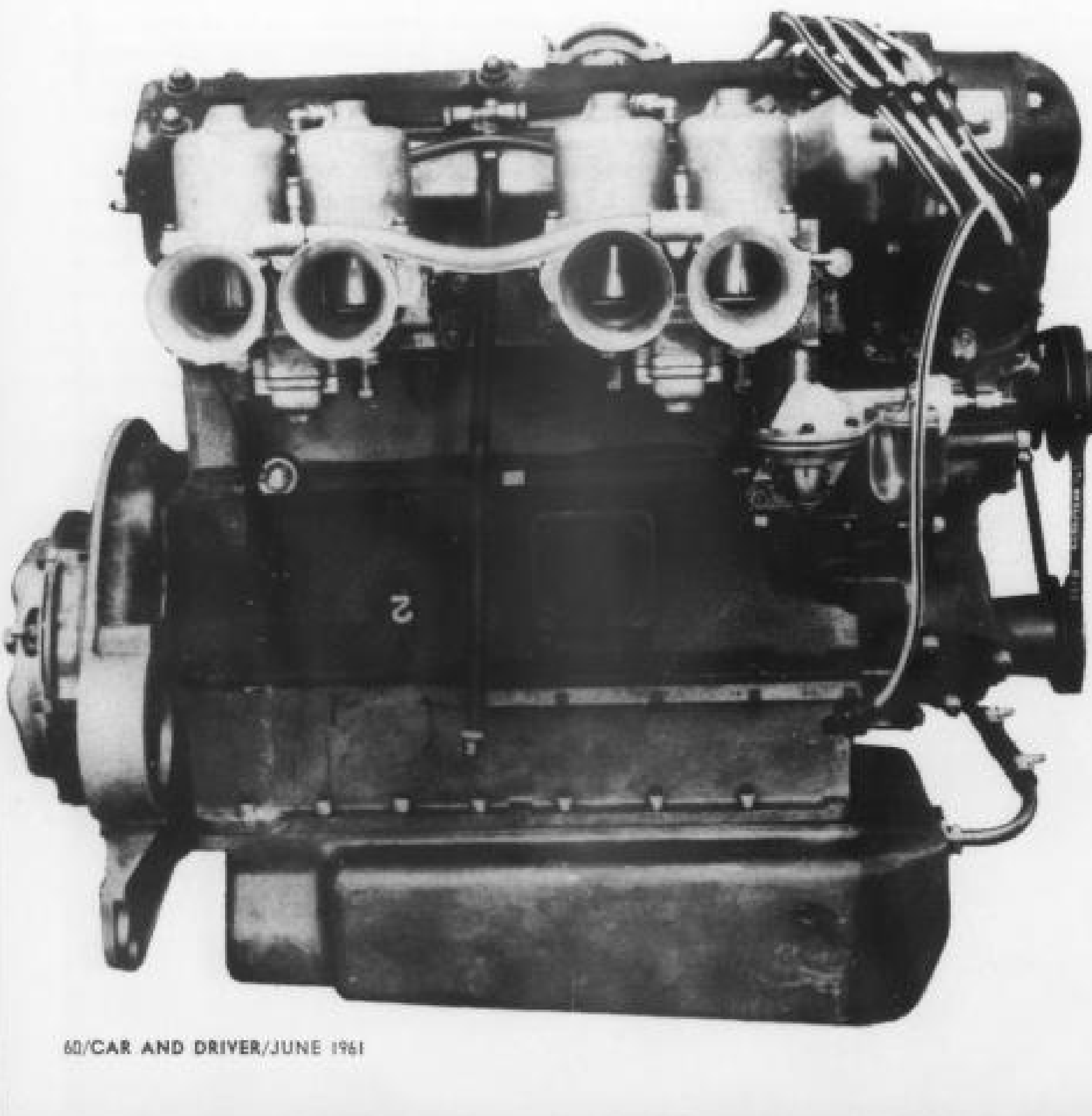
Die-cast aluminum pistons carry two compression and one oil rings, the crown form varying in accordance with the compression ratio required. The 1960 Le Mans engine (9.25 to one) had a raised but flat head; indentation for valve clearance hasn't been necessary on any TR3-S engine. Bore and stroke are 90 x 78 mm, giving a displacement of 1985 cc.

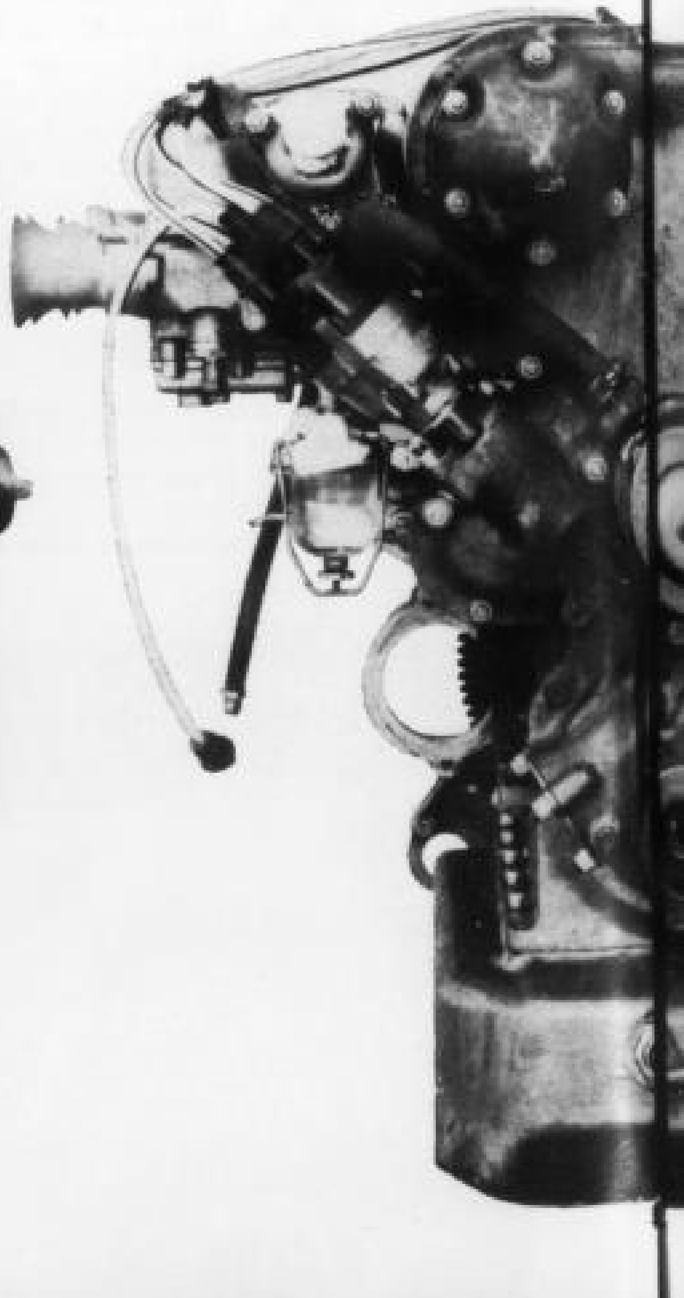
The cylinder head is cast in DTD424 alloy, very similar to general-purpose SAE 326. It has fully machined hemispherical combustion chambers disposing two valves per cyl-



Twin-cam's broad cylinder head looks typically British, with bolt-on intake piping at left. Valve seat inserts seem to be unusually thick.

Triumph's twin-cam is an alloy Dagwood sandwich: head, water jacket, block, crankcase and oil pan.





inder at an included angle of fractionally over 73 degrees. Valve slope is assymmetrical, with the exhausts inclined about 4 degrees more than the intakes. Valve material is nimonic steel, the head diameters being 1 15/16 inches for the intakes, 1⅝ inches for the exhausts. Valves carry two springs each and shut onto frozen-in seats with a Brinell hardness of approximately 360.

(Inserts to this specification were used successfully at Le Mans in '59, whereupon, on specialists' assurance that seats of half the hardness would be satisfactory, a switch was made before the 1960 event. Results confounded the experts. In the later stages of the race, all three cars suffered insert wear until their valves were finally devoid of clearance. This in turn precipitated deterioration of the valve seats themselves, seriously affecting power output. Overall, you'll remember, the Triumphs placed fifteenth, eighteenth and nineteenth out of twenty-five finishers, and were second, third and fourth in the 2-liter class. Rather interestingly, post-Le Mans tests with the clearances reset but the deckle-edged valves and pulped inserts still on duty produced outputs of 120 bhp.)

Connecting rod, with as-forged finish, has deep webbing on the big-end cap. Piston is slipper-type, having a skirt on thrust faces only.

BREATHING APPARATUS

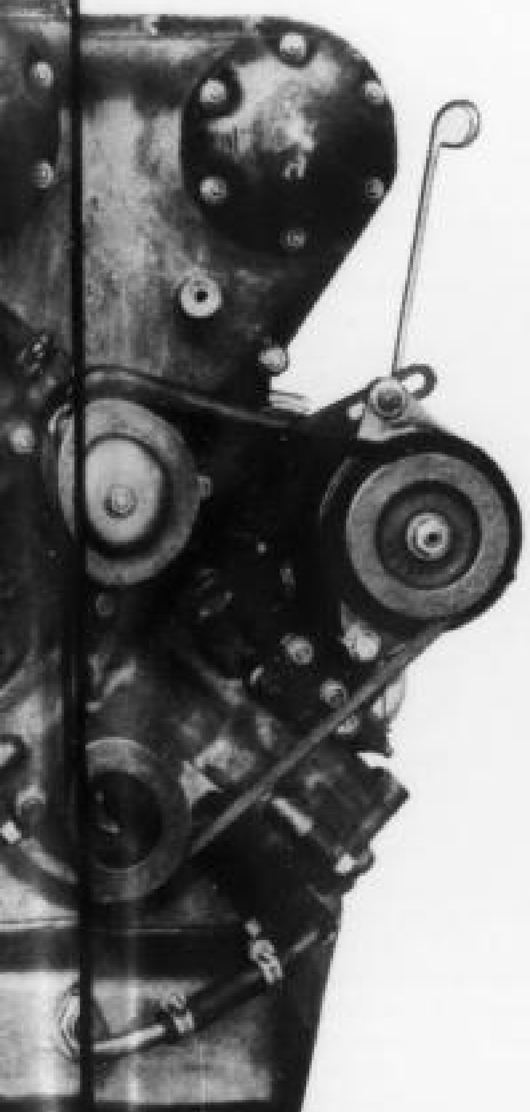
The twin camshafts are hollow, give a ⅜-inch lift and run in five 1⅛-inch diameter bearings apiece. Valve attack is via inverted bucket-type tappets working in cast iron guides and with shim adjustment. The camshafts are driven off the nose of the crank through primary and secondary duplex chains with Renold hydraulic tensioners and pad dampers. Long-reach 14 mm Lodge spark plugs screw directly into the head and are slightly offset from the longitudinal centerline, much further offset behind the lateral centerline.

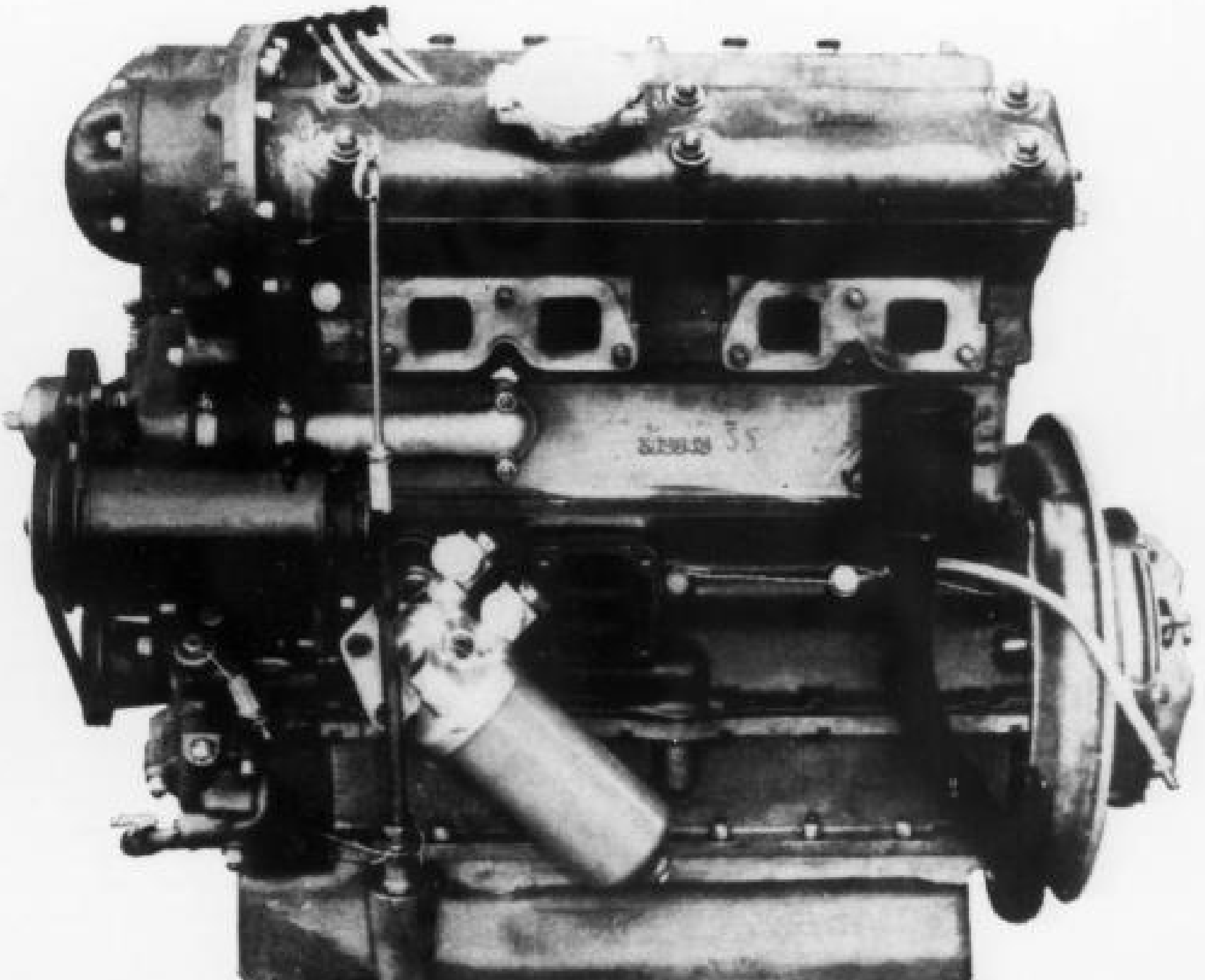
All ports are separate, the diameter of the intakes being 1 11/32 inches. Exhaust ports are rectangular, 1½ x 1¼ inches, and couple up to off-takes that unite cylinders 1 and 4, 2 and 3, 16 inches from exit points; a further 18 inches down the line they merge into a single pipe and silencer. Carburetion is by two dual-throat S.U.s, type DU6, with 1¾-inch bores. These make moderate use of ram effect, total distance from the lip of the bellmouth intakes to the head face being 12 inches.

SERVICEABLE AUXILIARIES

A TR3-S feature, designed to facilitate factory assembly and subsequent servicing, is the localization of the drives to the camshafts, oil pump, fuel pump, distributor and tachometer in a single and easily-detachable case forming the engine's frontispiece. This mates with machined faces on the crankcase and water jacket *(Continued on page 64)*

It's good for racing but it's actually designed for production, likely by extensive use of die casting.





SHAPING FOR SPEED

(Continued from page 44)

It may be accepted therefore that a vehicle of wide popularity is inevitably a compromise between numerous conflicting requirements, and most of these have been written about in one form or another fairly extensively in recent times. Such as has been written about shape, however, savours pretty much of the sort of stuff which appears in the women's glossy magazines about the creations of Hartnell, Balmain, Dior, *et al*, and this, goodness knows, provides little enough meat for those who take their motoring seriously. Let us, therefore, cast an objective eye on this question of shape.

There is a very direct relationship between the amount of power, and therefore the amount of fuel, required to propel any given vehicle through the air and over the ground at a set speed. Take a look at Fig. 2, which represents, nearly enough, the curve of the power required by the MG TC, the first European car to make any real impact in the American market. It will be seen that 60 bhp would be consumed in pushing this vehicle forward over the level road at 83 mph. Further, considering the dotted extension of the curve, it will be realized that beyond the maximum speed then available, an addition of 16 percent in bhp would have increased the maximum speed by rather less than 4 percent. With the TC and its direct derivatives, the TD and TF, the law of diminishing returns had come into operation with a vengeance. Something had to be done about it. But what?

For an elegant answer to this question it was first desirable to know something of the ultimate at which to aim. At first glance it may be thought that, with all the time and money spent by the nations of the world in the development of aircraft and projectiles, everything possible was already known about aerodynamics, certainly at the sort of speeds which the sports car designer is considering. But a moment's further reflection will recall the one essential difference, that aircraft and projectiles move freely in three dimensions, whereas the sports car moves, with luck, only in two, and the presence of the road has to be taken into account, including what goes on between the underside of the vehicle and the surface on which it runs.

Here we begin to see the first glimmer of one of the reasons why the MG Car Company, off and on over the past 30 years, has engaged in the "pastime" of record-breaking.

Thanks to the work of the aircraft industry, the amount of power required to propel a given shape through the air is known fairly exactly. Additional drag forces — usually lumped together under the head of "rolling resistance", comprising friction losses in the cycle parts of the vehicle, power losses in the tires, and turbulence between car and road — are much less exactly known, nor is it yet established that comparable conditions can be re-created in the wind tunnel with a simulated road consisting of a belt moving at the same speed as the wind. For long enough the MG engineers have recognized that the only way to be sure is to go and find out.

In every record-breaking attempt undertaken since 1937 and up to the present day — with the exception of those few where unforeseeable factors have intervened — MG engineers have known the precise power being generated at the speed obtained and the drag of the vehicle in free air. From this they have been able to calculate the incalculable, and have amassed a wealth of data which enables rolling resistance to be deduced with considerable accuracy in any given set of circumstances.

Fig. 1 shows in the dotted curve the total drag of the experimental car, EX 135, driven by Major A. T. "Goldie" Gardner under a wide variety of differing conditions between 1937 and 1952. The solid curve is that of the MG EX 181, with which Phil Hill exceeded 250 mph in October, 1959.

These designs represented what, at the time of their inception, was regarded as the ideal for maximum penetration, and had the merit of providing a known goal toward which the engineers would strive in the design of a passenger-carrying sports car. But, of course, before such a design could emerge, all manner of requirements, extraneous to the pure business of record-breaking, would have to be taken into account. Passenger cars for general acceptance must have doors which offer reasonably simple entrance and exit. Road wheels must be capable of being changed without too large a surgical operation. Cars for use on the road need headlamps, taillamps, and turn indicators, in positions prescribed by law. The car must have all-weather protection, be capable of carrying baggage and, not least, a passenger. Having said all this, and allowed for all these things, it is not an unrewarding exercise to view the MGA and mentally denude it of these essential excrescences. It is surprising how the basic shape of EX 181 begins to emerge.

The cost of the excrescences in terms of performance is, of course, high, and the dash line in Fig. 2 represents the total drag of the MGA in its complete state. Though this is a far cry from the idealized EX 181, it is a vast improvement on the TC. If one considers for the moment an available 60 bhp in both cases, it will be seen that shape alone has yielded 12 mph.

Where next? In the course of the researches into EX181 all manner of strange shapes were tried. Not least of these was EX 181/7, but the best potential advantages of this could be realized only when the lower edge of the vehicle was brought very close to the ground, a feature which, in the absence of some form of rubber or flexible skirt, made this form impractical for normal use. At the other extreme lay a vehicle pitched high in the air, so that it could be considered more nearly as a true projectile free of the influences of the ground, except where the essential wheels protruded through its underside. It is perhaps too early to say in which direction design will go, but where maximum penetration is a strong consideration the move will certainly be one way or the other.

—JT