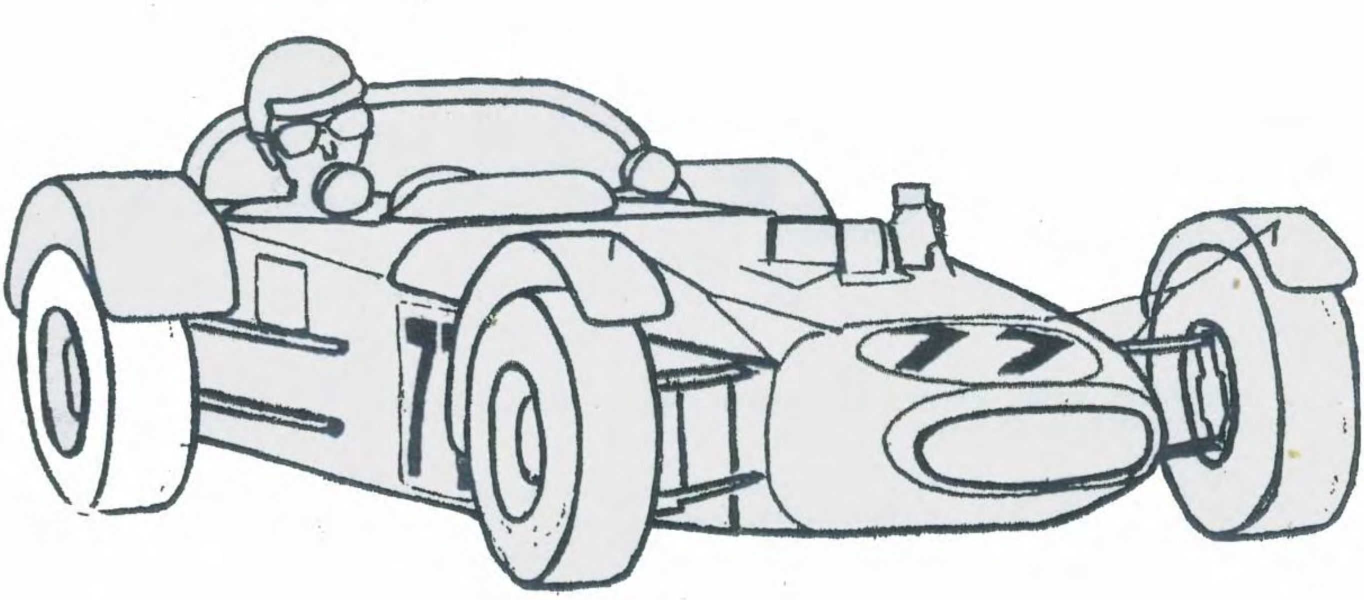
750 MC

750 MOTOR CLUB



RELIANT ENGINE TUNING

by Bryan Clayton

A 750 MOTOR CLUB PUBLICATION

Reliant Engine Tuning

by BRYAN CLAYTON

Edited by John Pitchers

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Foreword

As the 1970's begin, the 750 Formula is already into its third decade and anyone asserting that the Reliant engine was not an essential component in the continuing success of the formula would get very short shrift. However, it has not always been so and back in 1963 there was certainly no general consensus of opinion about an engine for the 750 Formula.

During the 1963 season much more discussion than usual had been in evidence about the need or otherwise for a replacement engine for the side valve Austin Seven unit. This speculation came to a head at the Annual Formula Discussion and as a result an *ad hoc* committee was formed, under the Chairmanship of Dennis Berry, and given the brief of considering the future of the 750 Formula.

It was soon obvious that the future of the 750 Formula hinged upon a decision as to whether or not to accept an alternative engine. The choice of engine was more difficult.

A range of alternative engines were reviewed and after a number of factors had been taken into consideration it became obvious that the engine which came nearest to the ideal on all counts was the Reliant 600 c.c. O.H.V.

After a detailed investigation of this engine an approach was made to the Reliant Motor Company to ascertain reaction to the use of their engine in a racing car. A visit to the Reliant factory followed and official blessing was received for the proposals.

The committee's recommendation for the 600 c.c. Reliant engine was presented at the April 1964 Board Meeting.

After further extensive discussions it was finally decided in the following autumn to allow the Reliant engine to compete for the 1965 season (i.e. immediately, for by now the 1964 season was over) with a 22 mm restrictor flange.

The first Reliant-engined 750 Formula car was Bryan Clayton's Vitesse, which was ready for the 1965 practice day at Castle Combe. Bryan had more than his fair share of trouble with the Austin side valve and naturally jumped at the chance to use a modern engine. It took some time for him to get the engine sorted out but by the end of 1965 he was beginning to achieve some competition success. Also by the end of 1965 one or two other Formula cars were using the O.H.V. engine.

For the beginning of 1966 the Vitesse was thoroughly sorted and Bryan had an excellent season, winning the Goodacre Championship. So in only its second season as a competition engine the Reliant 600 c.c. O.H.V. engine had won the Championship. From this fine beginning the engine quickly achieved dominance of the Formula and by 1971 Austin-engined cars were rare indeed.

The success of the Reliant engine is evidenced by the way in which the continuous engine development (all done by amateur tuners it should be noted) has produced faster cars year by year without any loss in reliability.

Bryan Clayton, who is regarded as a father figure in matters of Reliant engine tuning, has gathered together in this book information on competition modifications from sources throughout the 750 M.C. Some of the items have hitherto remained closely guarded secrets, whilst others are essential for any Reliant engine which is to be used in competition.

The contents should quickly make this the basic handbook for anyone wishing to go Relient racing.

Ron Sadler.

Introduction

Without an understanding of the factors that go into improving engine performance a lot of time and effort can be spent in producing an end product not much improved from the original. The object of these articles is not to be the "be all and end all" of Reliant tuning, but a set of guide lines for the average competitor, with a few hints and suggestions to avoid some of the many pitfalls of engine tuning.

The measurement of power developed is brake horse power (b.h.p.), which is calculated by the following formula:

$$\frac{\text{Torque x Revs per min.}}{5252} = \text{b.h.p.}$$

Torque can be defined as a force applied about a centre of rotation. An engine converts the energy created by the combustion of air/petrol mixture from a downward pressure on the piston and connecting rod, into a twisting force around the centre line of the crankshaft. Some ways of improving torque, and therefore b.h.p., are:

(*a*) An increase in r.p.m.

(*b*) An increase in the volume of the air/petrol mixture.

(*c*) An increase in combustion efficiency.

(*d*) An increase in cubic capacity.

R.p.m. can be increased by reducing the weight of reciprocating parts, such as pistons, connecting rods, valves and push rods; accurately balancing all these components, and raising the r.p.m. at which valve bounce occurs. The amount of air/petrol mixtures inducted can be improved by lengthening the period during which the inlet and exhaust valves remain open, enlarging the choke area, together with an increase in size of both the manifold and ports, smoothing out the flow path of the inlet tract, and increasing the area around the inlet valve. Combustion efficiency can be improved in the following ways: raising the compression ratio, increasing the exhaust scavenging effect by tuning the exhaust system which in turn improves the filling of the cylinders on their next induction stroke, and by improving the turbulence of the incoming fuel. By far the most effective way of improving performance is to enlarge the capacity but, as the regulations are, engine size is limited, so that's out.

Another point to consider is mechanical efficiency. The more you can do to increase the efficiency by decreasing internal friction, reducing weight and drag, etc., the more there is available at the flywheel.

Brake mean effective pressure (b.m.e.p.) is also a measure of efficiency as it indicates the pressure at which the engine works. The higher the pressure the more power the engine will give. There is a close relationship between b.m.e.p. and torque, which can be determined by:

$$\text{B.m.e.p. (lbs. per sq. in.)} = \frac{\text{Torque x 2473}}{\text{Cubic capacity}}$$

Provided that torque is maintained, the more the engine revs the more will be the power developed, in a given time. From these points it will be seen that to improve the efficiency of an engine the torque and b.h.p. must be improved, and maintained over a longer rev range.

Some of the modifications in the following chapters will be fairly easy, while others require the use of specialised engineering firms. However, this does not mean that to produce a competitive engine you have to spend large sums of money. Providing you have a reasonable set of tools and are prepared to spend time in the workshop, the return for a small outlay can be well rewarded. One of my basic thoughts is, if you have to have a job done, but you could do if given the tools, it's better to buy the tools and have a go yourself. You may have to attempt it a couple of times but at least you have the tools for the future. One of my most useful acquisitions was a pre-war lathe of fairly large proportions (I reckon you can always do small jobs on a large lathe, but not the other way round) which has more than paid for itself over the years. Another method of producing bits and pieces at a reasonable cost is to attend an evening institute for metalwork. If the institute has a fairly comprehensive machine shop and the instructor "guided" to your way of thinking, pound for pound, it can't be beaten.

Finally, cleanliness. I can't stress enough the importance of ensuring that any item, tool or workbench should be thoroughly cleaned before assembling an engine. I've seen so many engines damaged due to lack of care during building, either through dirt or machine swarf, that it's one thing I have a strong feeling about.

The Reliant o.h.v. engine

SPECIFICATION

General

700 c.c. Engine

Four cylinders. Bore 2·38 in. (60·5 mm). Stroke 2·40 in. (61 mm). Swept volume 42·7 cu. in. (700 cu. cm). Maximum b.h.p. 28·6 at 5,150 r.p.m. Maximum b.m.e.p. and torque respectively 122 lb. sq. in. and 34·5 lb. ft. at 3,100 r.p.m. Compression ratio 7·4 : 1.

600 c.c. Engine

Four cylinders. Bore 2·20 in. (56 mm). Stroke 2·40 in. (61 mm). Swept volume 36·5 cu. in. (598 cu. cm). Maximum b.h.p. 24·2 at 5,250 r.p.m. Maximum b.m.e.p. and torque respectively 119 lb. sq. in. and 29 lb. ft. at 3,100 r.p.m. Compression rato 7·8 : 1.

Description

The general layout of the engine is conventional, except for the use of wet liners and the aluminium cylinder block.

The distributor is mounted on a boss on the right-hand side of the crankcase between numbers one and two cylinders. An extension shaft coupled to the distributor drives the high capacity eccentric bi-rotor type oil pump, which is situated in the sump. The 600 c.c. engine has a vane type oil pump on early engines, a bi-rotor on later ones.

The mechanical fuel pump positioned below the distributor is driven by an eccentric cam on the camshaft. To the rear of the fuel pump is the replaceable full flow oil filter on the 700 c.c. engine (a replaceable by-pass filter is on the 600 c.c. engine) and the starter motor.

On the left-hand side of the engine are the inlet and exhaust manifolds and carburettor. An oil filler cap is located in the rocker cover and also incorporates a filter for the semi-closed positive crankcase ventilation system. The 600 c.c. engine has a crankcase ventilation pipe pressed into the cylinder block.

The dynamo is mounted low down on the left-hand side of the engine and is driven, together with the cooling fan and water pump, by a vee belt.

Engine Mounting

The engine and gearbox assembly has a three point mounting on bonded rubber mountings. The two front mountings are carried on angle brackets bolted to the front face of the front engine plate, the single rear mounting is carried in the gearbox rear housing.

Cylinder Block, Crankcase and Wet Liners

An integral cylinder block and crankcase of LM 8 aluminium is employed with "loded" centrifugally cast iron wet liners.

The skirts of the crankcase are extended below the crankshaft centre line to provide maximum rigidity and are joined together at the front and rear by removable rigid aluminium bridge pieces. These bridge pieces also provide a flat surface with easy sealing for the EN2A steel sump. The water passages between the liners are ·14 in. wide (·22 in. on the 600 c.c. engine), ensuring adequate cooling and the water jacket extends the full length swept by the piston rings.

The rear face of the crankcase is machined to carry the rear engine plate. Positive location is by two dowels and the plate is secured by six bolts.

At the front of the engine the water pump is spigot mounted into the block so that the whole of the pump rotor is positioned behind the front face. Below the water pump the front engine plate and the die-cast LM 1 aluminium timing gear cover are bolted to the front face.

The LM 22W aluminium bearing caps (LM 4 on early 600 c.c. engines) are secured by ⅜in. diameter high tensile steel studs and located by accurately machined gaps in the block. The large diameter drilled oilways are sealed with high pressure recessed socket type taper screwed plugs.

The wet liners, of high tensile centrifugally cast iron, are an easy push fit in the cylinder block and are sealed at the bottom by the use of Hylomar SQ 32/M sealant. On the 600 c.c. engine the seal is by a Neoprene "O" ring recessed in the bores of the block. At the top they are sealed by the cylinder head gasket, the liners protruding ·004 in. above the top face of the block. The bores of the wet liners are honed to a fine oil retaining surface.

Crankshaft, Connecting Rods and Pistons

Copper lead steel backed shells are employed for the main bearings carrying the high tensile steel forged crankshaft. Axial location is controlled at the front bearing by Babbitt steel backed washers located in recesses in the front and rear faces of the bearing cap. These thrust washers are circular with large width tags which engage in slots in the front and rear faces of the front bearing cap, thus preventing rotation. The crankshaft is dynamically balanced and has three large main bearings, 1¾ in. diam. by 1 1/16 in. long.

Immediately behind the rear bearing the shaft is enlarged to 2¾in. diam. On this diameter runs the Silicone synthetic rubber spring loaded lip type seal. The crankshaft rear oil seal is pressed into an aluminium carrier which is bolted and dowelled to the cylinder block rear face. The 600 c.c. engine has a groove machined to take a piston ring type oil seal. The ring is stationary in the aluminium housing bolted to the rear of the cylinder block, forming a labyrinth type oil seal. Front sealing is by a synthetic rubber spring loaded lip type seal, carried in the aluminium timing chain cover, sealing on the cast iron crankshaft pulley.

Three ⅜in. diameter set-bolts locked by a tab washer and one ⅜in. diameter dowel secure the 9⅞in. diameter flywheel, of BS 786 Grade 2 cast iron, to the flange on the crankshaft. A shrunk-on starter ring gear is fitted, made of medium carbon steel with induction hardened teeth. The flywheel is bored and fitted with a sintered porous bronze bush for the gearbox primary shaft. The 6¼in. diameter diaphragm spring type single dry plate clutch is located on the flywheel by two dowels and retained by six bolts.

Forged H section connecting rods made of EN8R high tensile medium carbon steel are employed. They have a length between centres of 4⅜in. In order that the rods may be withdrawn through the cylinder liner bores, the big ends are divided at an angle of 50° to the axis of the rod.

Copper lead steel backed bearing shells 15/16in. long x 1 5/16in. diameter bore are fitted. They are located by projections at their abutting faces, engaging in grooves machined in the caps and the roads. The bearing caps are located and secured by high tensile dowel type bolts locked by tab washers. The connecting rods are accurately weighed and fitted in matched sets to ensure even balance.

Bimetal wrapped bushes are pressed into the small end eyes, and burnish broached to give a mirror surface finish and accurate sizing. A small diameter countersunk hole is drilled in the upper end of the rod to allow oil to splash into the bearing.

Fully floating plain tubular section gudgeon pins, ·562 diameter, are employed, and they are retained by Seegar type circlips in grooves in the bores of the piston bosses. The pins are case hardened and precision ground and lapped to a fine surface finish. The gudgeon pin is offset in the piston 0·04in. towards the thrust side of the engine.

The flat crowned pistons are of low expansion aluminium alloy, being of the slotted skirt type. The pistons have horizontal thermal slots level with the oil control rings to control the flow down the skirt and thus preventing local overheating. In each piston there are two compression rings and one oil control ring, all above the gudgeon pin. The top compression ring is of rectangular section, the second compression ring is taper faced, finally a slotted oil control ring with two narrow ring lands is used, all rings are granodised.

Timing Gear, Camshaft and Valve Gear

The timing drive arrangement is conventional. The cast iron fan pulley is located on a 1in. diameter extension of the crankshaft and a lip type oil seal is employed. A ⅜in. diameter bolt secures the pulley and sprocket to the crankshaft. This bolt is locked by a tab washer which registered in the keyway in the hub of the pulley. The pulley and the sprocket are driven by a single Woodruff key.

A single row timing chain of ⅜in. pitch transmits the drive from the crankshaft sprocket to the camshaft sprocket, the centres of which are 3·866in. The camshaft sprocket is located and secured to the camshaft by two dowel type bolts locked by a tab washer. A 3/16in. thick thrust plate bolted to the front wall of the crankcase registers in a groove in the front diameter of the camshaft. The timing chain tensioner on the 700 c.c. engine only comprises a spring leaf with a synthetic rubber pad on which the chain roller runs.

All three bearings of the camshaft are fitted with bimetal wrapped bearings.

The camshaft is of Monikrom cast iron and the cams are chilled. Between the cams the shaft is ⅞in. diameter. The cam profiles have been designed to give silent operation and to avoid characteristics that would apply under severe loads to the valve gear.

Chilled cast iron tappets of the piston type are utilised. The wall thickness of the tappets is only ·078in., thus they are of light construction and inertia loading of the valve gear train is kept to a minimum.

The push rods are 7/32in. diameter and their effective length is 6 5/16in. On each there is a spherical lower end and a cupped upper end. At one end of the shell moulded cast iron rocker is the tappet adjusting screw, secured by a locknut, the pad at the other end being chilled. The rocker ratio is 1·06 : 1.

The induction hardened rocker shaft is carried on four aluminium pedestals, with the rockers on each side of them. Coil compression springs hold the inner rockers against the pedestals. Small spiral springs are fitted at each end to hold the outer rockers against the outer pedestals. Collars pinned at the ends of the rocker shaft retain these springs. The ends of the rocker shaft are sealed with nylon plugs (steel on the 600 c.c. engine). Oil to the rockers is fed to the shaft through a drilled hole in the rear pedestal.

The rocker shaft pedestals are die-cast aluminium. The rocker shaft is located by a set bolt in the rear pedestal registering in a hole in the shaft.

The valves are arranged in line in the vertical plane. Single valve springs are fitted, the lower end of the spring seat in a shallow counterbore around the valve guide housing, and the upper end abuts against a shouldered washer retained by split tapered collets. Inverted rubber caps are fitted to the valve stems over the guides to prevent excessive quantities of oil from flowing into the guides. All the guides are of plain cylindrical section. (The lower ends of the exhaust guides on the 600 c.c. engine are counterbored.)

The inlet valve has a larger head than the exhaust valve for good breathing. The exhaust valves are made of special heat resisting steel for long seat life.

The inlet valve and port dimensions are:

700 *c.c. engine:* Valve head 1·030in. diam., throat diam. ·922in. and the valve stem ·281/·280 diam.

600 *c.c. engine:* Valve head 1in. diam.

The exhaust valve and port dimensions are:

700 *c.c. engine:* Valve head ·905in. diam., throat diam. ·797in. and the valve stem ·281/·280in. diam.

600 *c.c. engine:* Valve head ·87in. diam.

The valve seats (which are of sintered iron) are shrunk into the cylinder head.

Cylinder Head, Manifolds and Carburettor

The low pressure die-cast LM8WP aluminium cylinder head is of simple yet sturdy design, the main masses of metal being disposed as evenly as possible to avoid thermal distortion. The head is held by ten large diameter studs and nuts positioned close to the wet liners and three smaller studs on the push rod side to provide even compression of the asbestos (with steel eyelets) cylinder head gasket. These extra three studs do not appear on the 600 c.c. engine. The push rods pass through drilled holes in the cylinder head. The water jackets are cored all around the housings of the inlet valve guides, as are those for the exhaust valve. Similarly, the exhaust and inlet valve seats are completely surrounded by coolant.

The combustion chambers are of the inverted bath tub type and are offset towards the left-hand side of the cylinders. This arrangement enables the sparking plug bosses to be incordorated on the left, where the plugs are readily accessible for servicing. It also leaves a shoulder on the right-hand side, which gives a "squish" effect.

Individual inlet ports give good distribution and ensure low fuel consumption.

The cast iron exhaust manifold is beneath the cast aluminium induction manifold and both are bolted to the cylinder head. A local hot spot is formed under the carburettor to assist cold starting.

700 *c.c. engine:* A Zenith 30 IZ downdraught carburettor with a 20 mm diameter venturi is mounted on a $\frac{1}{4}$in. thick insulating block on top of the riser. The jet sizes are as follows:

Main 95, correction 175, auxiliary 45, and auxiliary air bleed 80.' Fuel is supplied by an AC mechanical pump actuated by an eccentric on the camshaft.

600 *c.c. engine:* A Solex B28Z1C2 downdraught with a 19 mm diameter venturi is on a $\frac{1}{4}$in. thick insulating block on top of the riser. Jet sizes are as follows:

Main 100, correction 160, auxiliary 120. Fuel is supplied by a mechanical pump actuated by an eccentric on the camshaft.

Water Pump and Cooling System

The pressurised cooling system is of the impeller assisted thermo syphon type with the water pump bolted to the front wall of the cylinder block. The water pump is driven at 1·21 times engine speed.

Coolant is circulated from the base of the radiator up through the pump and into the cylinder block. The coolant then circulates through the cylinder block and to the thermostat located at the front of the cylinder head. At operating temperature hot coolant is returned to the radiator top tank.

A wax type, 88°C, thermostat in conjunction with a by-pass tube assists in the rapid warming up of the engine.

The water pump construction is as follows:

The impeller is pressed on to the rear end of the spindle. A spring loaded, moulded rubber, water seal with a carbon thrust ring is carried in the nose-piece of the aluminium housing and bears against the front end of the boss of the impeller. In front of the seal a Neoprene thrower ring works in a drainage space. A sealed tubular bearing with two rows of balls carries the spindle. It is packed with grease on assembly and requires no further attention during service. Two grooves are machined round the spindle to form the inner races. The tubular outer race is located in the housing by a spring wire clip. The hub of the pressed steel fan and pulley is pressed on to the front end of the spindle.

Oil Pump and Lubrication System

The engine lubrication system is of the forced feed type, the oil being circulated by an oil pump mounted on an aluminium extension casting bolted to the bottom of the cylinder block and driven by a spiral gear on the camshaft.

The oil pump may be of the eccentric bi-rotor type or the sliding vane type.

Oil from the sump is drawn through a gauze screen at the bottom of an inlet pipe attached to the oil pump extension casting and into the pump. The oil pressure is controlled by a spring operated ball type relief valve situated in the side of the cylinder block which when open bleeds oil back into the sump.

Oil from the pump flows under pressure through a full flow filter mounted on an adaptor and screened to the side of the cylinder block, to the main oil gallery. A switch for the oil pressure warning light or an adaptor for an oil pressure gauge is located in a tapping into this gallery.

From the main oil gallery the oil passes through drillings to each main bearing. Drillings in the crankshaft front centre and rear journals feed oil to the big end bearings. The camshaft bearings are fed via drillings in the cylinder block from the front, centre, and rear main bearings. The timing chain and sprockets being lubricated by a metered jet of oil from the front drilling.

A groove machined on the camshaft rear journal controls the oil feed to the rocker shaft on the 700 c.c. engine, which is thus pressurised every revolution of the camshaft. The oil is fed through drillings in the cylinder block, head and rear rocker pedestal to the hollow rocker shaft to lubricate the valve rocker. Drillings in each rocker allow for lubrication of the valve stems and push rod ends. The oil feed to the rocker shaft on the 600 c.c. engine is fed direct from a gallery running across the rear of the block.

Oil from the rockers drains through the push rod holes and lubricates the tappets and cams as it returns to the sump through the drain holes.

Ventilation System

A semi-closed positive ventilation system is fitted. The crankcase fumes being drawn up through the oil filler cap, through the rubber hose coupled to the air cleaner by the suction of the air intake. A positive flow of air through the engine to purge all crankcase fumes is thus ensured, the fumes being burnt during combustion in the cylinder.

Ignition Equipment

A Lucas type LA 12 ignition coil (12 volt) supplies a Lucas contact breaker and distributor which has a centrifugal and vacuum controlled automatic advance and retard mechanism.

Autolight AG42 sparking plugs and Lucas radio-suppressed high tension leads are fitted on the 700 c.c. engine, with Lodge HLN sparking plugs for the 600 c.c. engine.

Clutch and Gearbox

The clutch is a 6¼in. diam. Borg and Beck unit on the 600 c.c. engine, Laycock on the 700 c.c. engine. I assume that most competitors will choose to convert a close ratio A7 box to suit.

In common with most modern engines the clutch and flywheel are completely out in the open behind the crankcase, i.e. there is no bell-housing on the engine, it is all on the gearbox. This is, of course, in contrast to the Austin Seven where the flywheel is contained within a bell-housing on the engine itself. The result is that in order to retain the clutch release mechanism on the A7 gearbox a collar or spacer about 4 or 5 inches in depth, depending upon the exact method used, will be needed between the engine and gearbox.

One method of transferring the drive from the engine to the gearbox is to make up a shaft with a male Borg and Beck spline on one end to fit the Reliant clutch, and with a male Austin spline on the other end to fit the A7 gearbox input shaft (the splined end of a Ford E93A gearbox primary shaft appears to fit the Reliant clutch spline).

The overall diameter of the Austin clutch withdrawal race is greater than the corresponding washer device which operates the clutch on the Reliant engine, therefore this should have an adaptor brazed on to match the diameter of the Austin race. This adaptor looks rather like an inverted top hat.

This method is only intended as a guide to the amount of work involved in the conversion, as there are many alternatives.

Purchase Price

A special purchase price for 750 Club members has been negotiated with the Reliant Motor Co. Ltd., as follows:

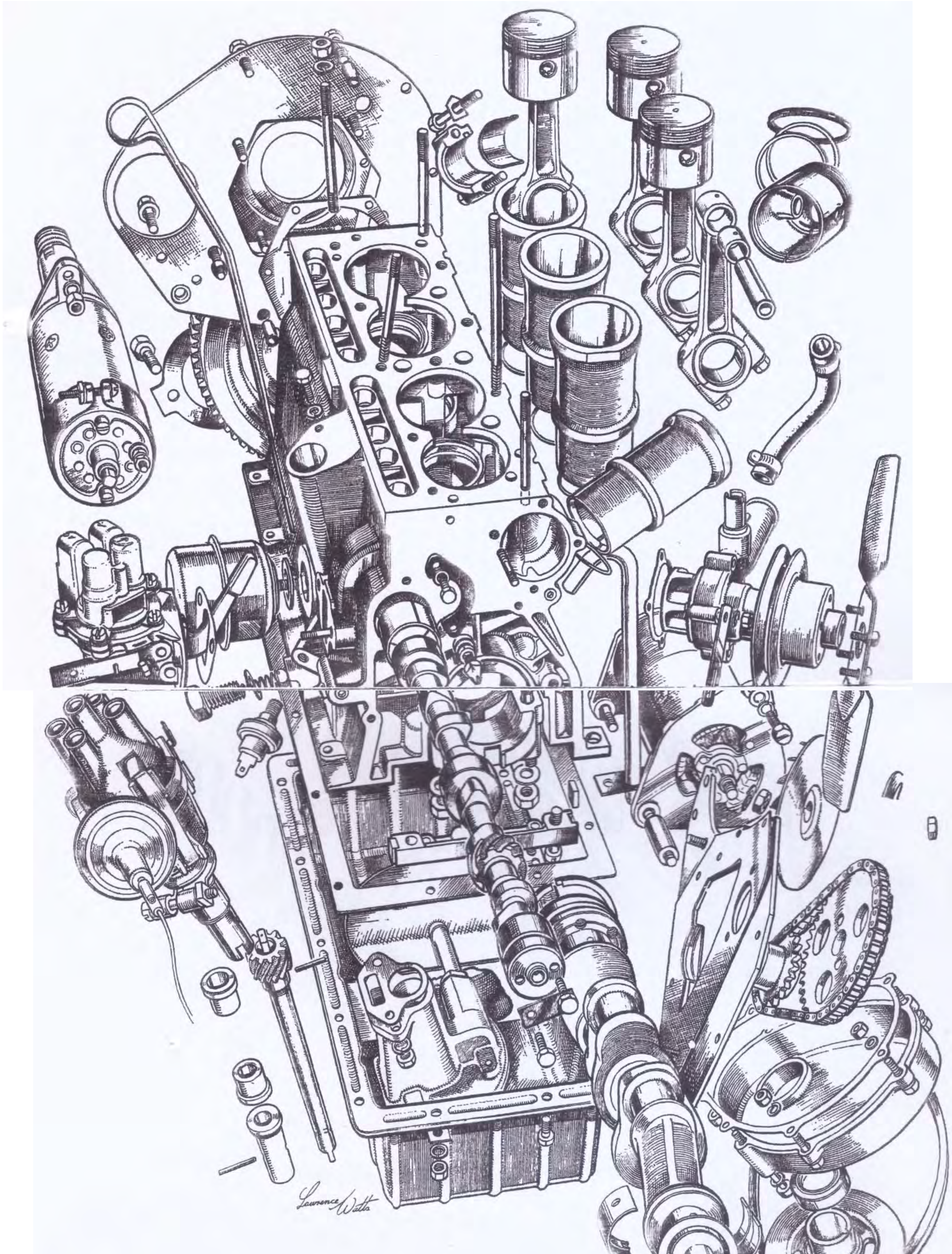
Engine unit to catalogue specifications and including the following accessories:

- Clutch unit.
- Dynamo complete with pulley.
- Starter.
- Carburettor (downdraught).
- Fan.
- Fan belt.
- Air cleaner.
- Water pump complete with driving pulley.
- Oil filter.
- Distributor complete with plug leads, vacuum control and pipe induction manifold.
- Sparking plugs.
- Fuel pump.
- Thermostat complete with by-pass pipe.
- Temperature gauge transmitter.
- Oil pressure switch.

Nett weight 138 lb.

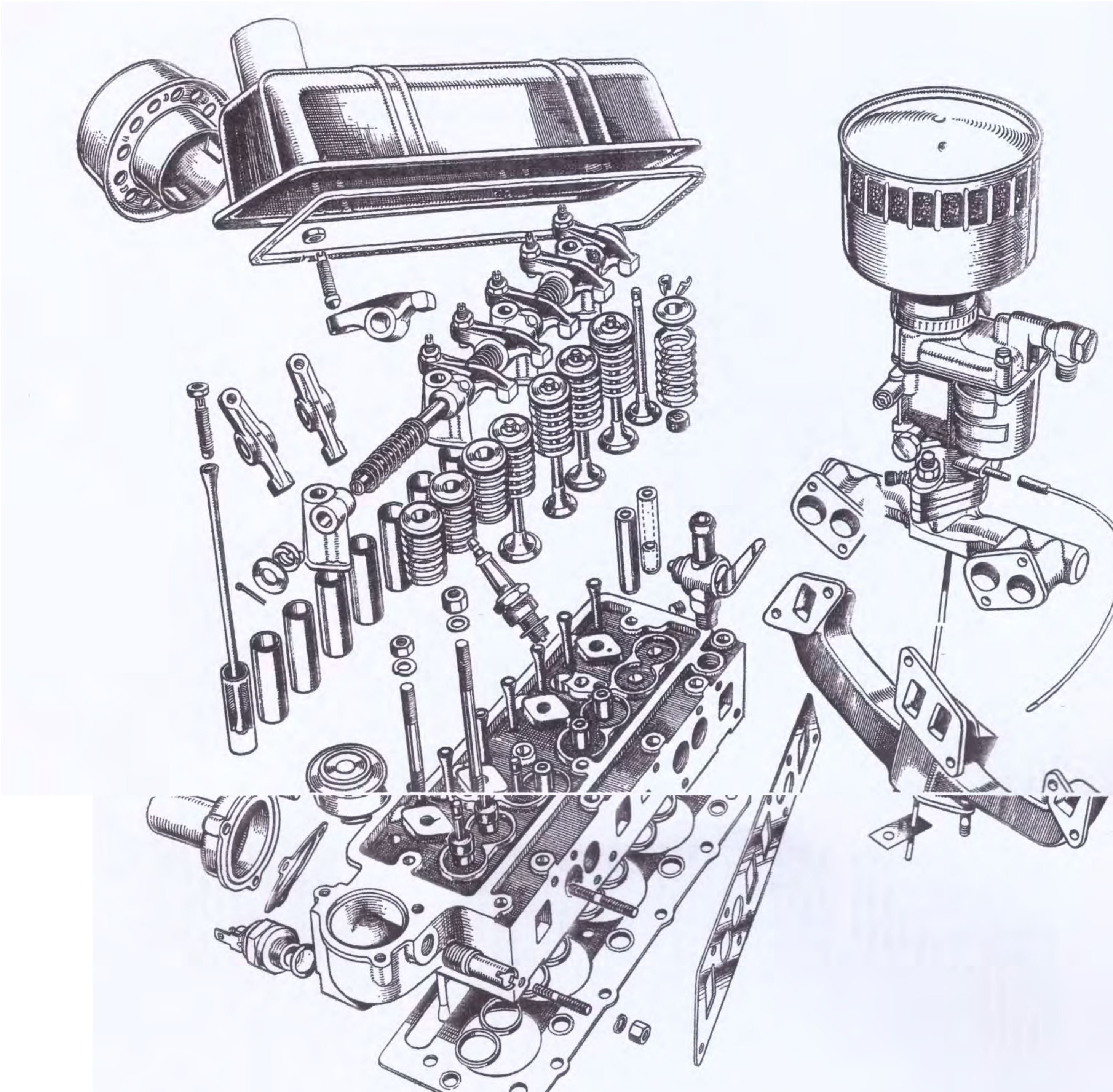
(Price and specifications are subject to alteration without notice.)

In order to keep the price as low as possible the Reliant Motor Co. Ltd. do not want to involve their dealers and distributors in the sale of engines to Club members, therefore all engines purchased at the reduced price will have to be obtained directly from the factory, either by collection or road or rail. It will first be necessary to obtain an official letter from the 750 M.C. General Secretary confirming that the intending purchaser is a paid-up Club member, and that the engine is required for racing. This letter, together with the necessary cash, should then be forwarded to The Reliant Motor Co. Ltd., Two Gates, Tamworth, Staffs, and individual arrangements made for the delivery of the engine.

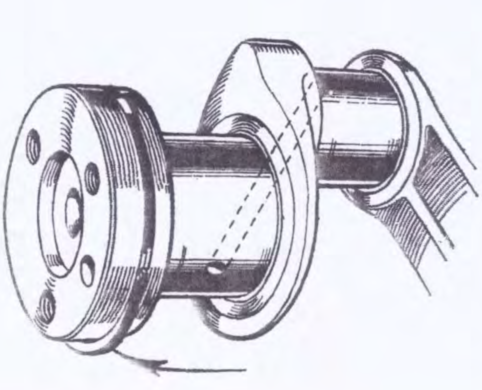


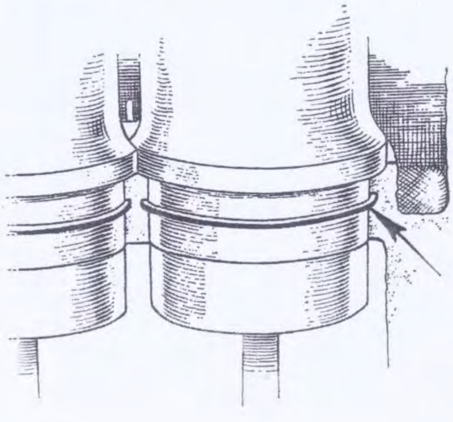
THE RELIANT 600 ENGINE

EXPLODED VIEW OF THE BLOCK/CRANKCASE UNIT



EXPLODED VIEW OF THE CYLINDER HEAD





Engine Tuning

The standard Reliant 600 O.H.V. engine is basically a robust unit, producing approximately 24 b.h.p. at 5,250 r.p.m. Whilst this is OK for the road vehicle for which it was intended, the b.h.p. figure for competition use needs to be somewhere around 45. As there is, to my mind, no substitute for cubic capacity for improving torque, the first step is to increase the standard bore of 2·20in. by the maximum allowed under the regulations. (See appendix for converting a 700 c.c. engine to 600 c.c.) An overbore of ·080in. gives a capacity of 642 c.c. using the mandatory standard stroke of 2·4in. Racing pistons are available from Pistons (Coventry) Ltd. and are of solid skirt construction and oval ground. A standard piston as supplied in a production engine should not be used as the oil drain behind the scraper is a slot, which, if the engine revs over 6,500, splits and leaves the piston in two parts. On the racing piston this drain is a series of holes. Another point is that a Reliant piston with standard rings, if used at high revs, with the obvious rise in piston speed, will undoubtedly break rings. The rings supplied on a Coventry piston are 1/16in. cimpression and 3/32in. oil control. When ordering racing pistons always specify Seegar type gudgeon pin circlips. These pistons were originally patterned for the Austin 747 c.c. engine so the gudgeons are of ½in. diameter. Early Reliant rods had ½in. small ends, later replaced by 9/16in. The later type rod small end bush can easily be replaced by a ½in. bush, still available from dealers, which will require honing out for a good fit, or the gudgeon pin hole in the piston accurately bored out to 9/16in. To decrease weight and friction the piston skirt should be shortened to just below the pin boss, with the inner diameter tapered to assist removal of surplus oil from the cylinder wall. The piston crown should only be skimmed if the liners have for some reason had their top faces machined. The obvious exception to this is when ensuring that the piston is at least level with the top of the bore at T.D.C. Don't, however, remove more than ·030in. as it makes the piston rpone to collapse. For the maximum squish efficiency, however, it's well worth having the liners skimmed to allow the piston to protrude ·005in. (not forgetting to have the block machined by the same amount). Pistons should be matched accurately for weight with certainly no more than one gramme difference between lightest and heaviest.

When the block is bored the liners will have to be removed; if boring is attempted with the liners in situ they cannot be held firmly enough to prevent them from either moving sideways or, in some cases, revolving in their housings. (I always had the liners bored a good ·080in. to give larger clearances for racing and to lessen the time required for running in.) Replacement of the liners is straightforward, but new bottom sealing rings must be used on the earlier engines. Remember that the liners are retained in their housings by the pressure of the cylinder head and at no time should they be less than ·004in. proud of the block. If the block requires skimming to eliminate any warping or indentations, the liners must be removed before machining and skimmed independently by the same amount.

The con rods are of high tensile carbon steel with a centre to centre length of 4⅝in. This. with a stroke of 2·4in., is a 1·95 to 1 length to stroke ratio, giving a rod sturdy enough for current power outputs. I have found that whilst a set of rods in a production engine are pretty well matched for weight, there can be a substantial difference between sets.Reliants have indicated that as far as they know there is no difference in rod weight, but I have found that there is quite a variation. If you have to replace one rod in a set, a little time spent comparing weights is well worth it, as it reduces work later when matching all four rods. All that is required to improve the rods is to file or scrape away any marks or indentations to relieve the stress raisers; a final rub with emery to remove the roughness of the casting, while probably not contributing much, does help to prevent surplus oil clinging to the rod. However, before starting any work on the rods have a careful check that the small eyes are central in their bosses, as on some rods I've seen the eyes have been as much as 1/16in. off centre. Finally, the rods should be balanced both for overall weight and end for end. If you have access to a chemist's spring balance and a bit of patience, an accurate job can be done, or, alternatively, the average cost of professional matching is about £6 (Laystalls give 25% off on production of a Club membership card). Obviously, it's not much use having rods matched if the piston aren't, and vice versa.

The forged crank of EN8 material appears adequate, provided the usual attention is paid to balancing and stress relieving. However, the crank is suspect in one place, the rear web. Crack detection is essential before considering using a crank, and again preferably mid-season; certainly at least once a year. (Some current 700 production engines have cranks of EN16 which give a longer bearing and fatigue life.)

On both these cranks the rear web has a drilling from the rear main, through the web to number four journal; no obvious method of preventing a breakage across this web comes to mind, so it's a case of regular crack detection. Big end bolts should be replaced every time they are removed, but inspect new ones prior to use, as occasionally some are fractionally too long. This does not become apparent when assembling as they butt up against the end of the blind hole in the rod, so that although a correct torque figure may be read the bolt is not holding the cap tight. Results of this are run big ends or, at worst, a rod lets go. One final point on rods, never use the Reliant tab washer. As the material used is considerably softer than either the cap or the bolt, under racing stresses the tab washer compresses, effectively loosening the big end cap. It's better to use either plain steel washers with Loctite on the bolt, or steel spring washers.

The standard Reliant flywheel can be lightened quite safely by approximately three pounds. The best place to remove metal is from the periphery as long as a step is retained to locate the starter ring. The step need be no more than ⅛in. wide. Any further metal can be skimmed from the thick part of the flywheel on the front side, in other words nearest the block. A nine spring pressure plate from the Triumph Spitfire is ideally suited; it fits as a direct replacement and eliminates clutch slip at high revs. The only problem is convincing the storeman that he's blind and that the six springs on your exchange plate are really nine.

Standard Reliant Glacier or Vandervell bearing shells are adequate, providing they are not of the aluminium tin variety. Assuming the journals have been ground (preferably ½ thou undersize) to once again give racing clearances, only a minimum of running in will be necessary. I'm of the opinion that too much running in at low revs is not always a good thing as a ridge of carbon is built up at the top of the bore, and the first time you really use the revs the chances are a ring will break. A couple of centre main caps have broken in the past, probably due to the material used on earlier engines, LM4. The standard cap is now of LM 22 which ought to be stronger, but I still recommend the

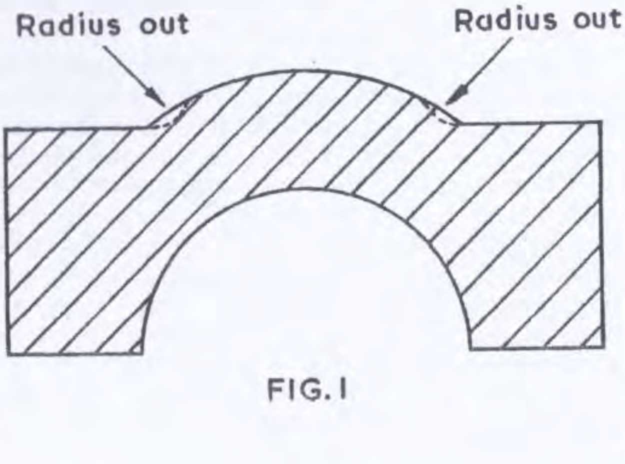


FIG. 1

following modification. Breakages always occur from the inner corner of a spot facing to the centre of the cap. Radiusing out the corner (as Fig. 1) has not totally cured the problem, so to be reasonably confident it's better to replace the cap with a dural block. The only snag here is that you must have absolute faith in your line borer, as any metal removed from the block ruins the whole job. There has been an engine utilising a mild steel centre main cap, but I'm dubious about the different expansion rates between block and cap. The cap I had made by Ambica Engineering was first class and gave no trouble whatsoever. The other alternative, of course, is a steel strap across the cap which, while effective, to my mind can't equal a solid cap, even though somewhat cheaper. The way to make a strap is as follows. What is required for each strap is a block of mild steel, 3½in. by 1in. and at least ½in. deep, together with two studs ½in. longer than the originals to take up the extra depth. The following diagram (Fig. 2) shows the construction. However, if caps are modified on all three journals the end ones will prevent the sump from seating if longer studs are used. A way of overcoming this is with the strap counterbored to take Allen cap bolts to replace the studs.

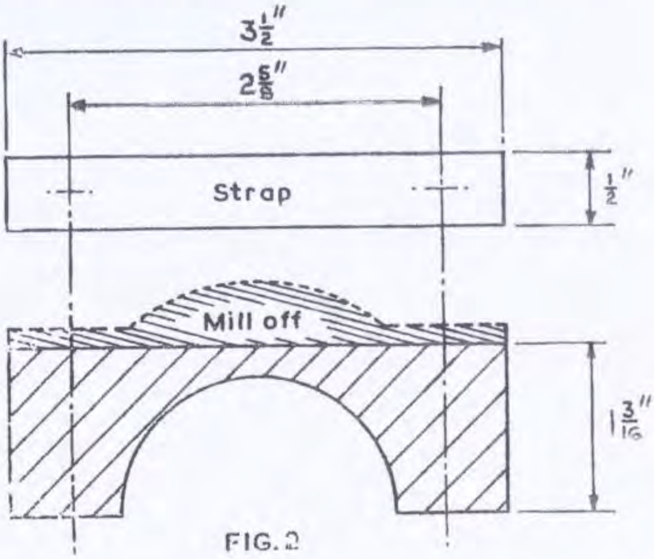


FIG. 2

It's easier to assemble the rear main oil seal cover on to the crank prior to fitting the crank to the block (unless you have two dozen spaghetti-type fingers), not forgetting to "goo" the gasket to the cover first. Incidentally, to my mind, there is only one jointing compound, Hylomar. It's dearer than other brands but the extra cost is well worth it as, provided the instructions are followed, a perfect joint is obtained. With the crank assembled on the block and the caps tightened down to the correct torque, accurate location of the rear aluminium housing used on early engines is essential. The object is to tighten up the six bolts evenly so that a ·004in. feeler can be inserted between the crank and the housing right round the periphery of the crank. This is important as the labyrinth type oil seal is not effective unless the ring is central in the crank groove. Later engines have a silicone synthetic rubber spring loaded lip seal which, as the location of the housing is by dowel, does not require accurate positioning. The thrust washers on either side of the front main cap need watching. To prevent them rotating, gently bend the locating tabs toward the recess in the cap to give a more positive location. It once took me an evening to fathom out why the crank locked solid every time I tightened the crank pulley; what was happening was that the thrust washers had rotated!!

Cam bearings are better left in place unless it is essential replace them. A "drawing" tool is the only way of geting them in accurately. A standard cam for competition use is out of the question. Comparisons of competition cams, both past and present, together with a standard cam, are as follows:

	Stan-dard	RRC	RRF	RRX	*Newman* 711	712
Lift	·212″	·270″	·295″	·290″	·285″	·300″
BDTC	10°	40°	50°	45°	45°	54°
ABTC	50°	80°	90°	85°	85°	90°
Gap		·015″	·018″	·018″	·014″	·017″

The RRC, used during the first couple of seasons, revved to about 8,000 r.p.m. This was ideal for the first year of development as it was not too violent, and quite tractable at low revs. During 1966 the first RRF was tried, which immediately turned the car into a race winner. Both myself and Peter Danby used the RRF in our championship engines, and until the introduction of David Newman's comparable 711 cam, was the only worthwhile cam around. An experimental one-off I used was the RRX which is listed above for comparison. Whilst the timing on both the RRX and the 711 is shorter than the RRF, they have a greater degree of flank acceleration, giving in fact a longer opening period. The latest cam from David Newman is the 712, which appears to be a further improvement over previous ones. All these current cams rev quite freely and, providing that gear ratios are right, will attain 9,000 plus. One tip here worth remembering is not to handle a new cam that has been Parkerluberised without first soaking it in oil. The coating makes it prone to picking up dirt from your fingers which impregnate the cam.

It is vital that the following point is observed. A reference to the diagrams in the appendix will show what I mean, but basically it's this. The 600 engine camshafts differ from the 700 ones in that they do not have the groove in the rear bearing housing to feed oil to the rocker shaft. A groove can be filed in with the edge of a flat file as long as the dimensions as shown on the diagrams are followed. If this is not done oil does not pass to the rockers, with diastrous results. An alternative is to run a ⅛in. bore pipe from the rear plug on the side gallery to the plug at the rear of the head. The end unions should be soldered up and drilled 1/16in. to restrict the flow.

One factor which determines the amount of lift on a cam is the size of the follower. An experiment which might prove worthwhile is to bore out the follower holes in the block and fit larger ones, possibly from the BMC range. Cam followers themselves can be lightened by removal of the top edge. The amount to be taken off is determined by the cam lift. You should end up with the top just proud of the cam follower bore when the valve is fully closed, i.e. on the back of the cam. I have skimmed metal from the inner surface and as long as not too much is removed appears to work satisfactorily without causing a follower to collapse.

Oversize valves, to my mind, do not appear to be beneficial and are probably detrimental at high revs due to the masking effect at low lift. The area to the outside of the inlet valve is governed by the bore and cannot be encroached upon by any worthwhile amount, so an increase of valve head size reduces the passage for the incoming gases. If larger valves are considered necessary, however, the answer is to offset the valve guides.

Even retaining the original size valves, the benefit gained from moving the inlet nearer the exhaust has proved well worth the effort. What is involved is to remove the original guides from the head, drill and reamer out the guide holes and fit oversize guides. It is possible to move the centre line of the valve an ⅛in. towards the exhaust valve before problems are created by the rockers. Even then relieving the sides of the pedestals, or the rockers themselves, is not difficult, and brings the rocker pad central once again over the valve stem. As this naturally runs the push rod at a slight angle the push rod holes may have to be relieved, depending on the amount of offset. All that remains is an alternative valve seat insert.

The guide hole is opened up and reamed out to ¾in. and the hole filled in with a plug. Either mild steel, bronze or cast iron can be used provided it's ·0002/·0004in. bigger and shrunk in. This is then drilled and reamed out to the correct offset, to suit the valve stem. A larger outside diameter valve seat insert, from mild steel, is turned up. The new recess for the seat insert is milled into the head and the insert, once again, shrunk in. A final blending of the pocket to suit the insert finishes off the job.

As for the valves themselves, standard Reliant ones are quite suitable. They can, of course, be lightened by the removal of metal (as Fig. 3), to once again decrease weight.

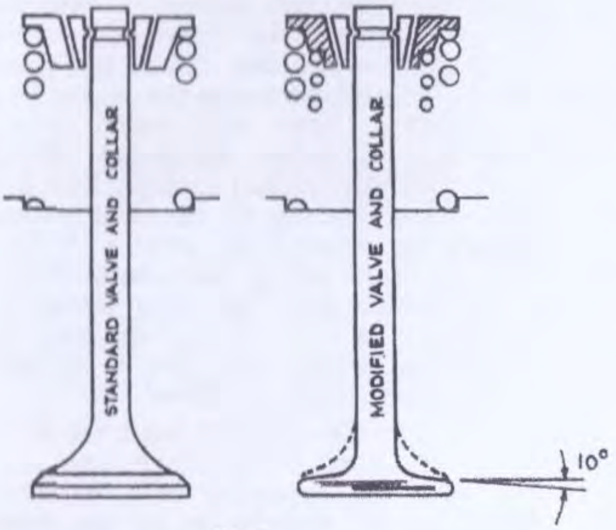


FIG. 3
VALVE LIGHTENING AND SPRING COLLAR MODIFICATION

The main effort, however, should be to improve the gas flow. The underside of the head is cut at 10° to the top face until it merges into a radius with the valve stem. This can be drawn on paper and then transferred to a metal template to use as a pattern when turning the valve to the new shape. Basically the head should be modified to a "penny on a stick" type by removing excess metal from both and top and underside. Before machining valves set them up in the head, coat the seat insert with engineer's blue and rotate the valves a couple of times, which will transfer the blue to the valve head, giving you an accurate line to work to. Do not try to remove too much from the top of the valve because the extra strength of valve spring used will, in all probability, curl the periphery of the valve head, and eventually break it off. Try to aim for a 100 thou thickness at the edge. Valve seats should be of the order of ·030in. wide for inlets and ·060in. for exhaust. The standard Reliant valve stem rubber seals serve no purpose on a racing engine and can be dispensed with. A good starting point for springs are Terry's Anglia single extra strong silicon chrome, Part No. VS 451550. You may find, however, that the O.D. of the new spring is slightly larger than the I.D. of the retainer cast into the head. A slight relieving with a rotary file around point D on Fig. 4 is the answer. A reference to Fig. 3 will also show the modification to the spring cap if double springs are used. It's easy enough to make up a mandrel to hold the cap in a lathe to turn off the required amount.

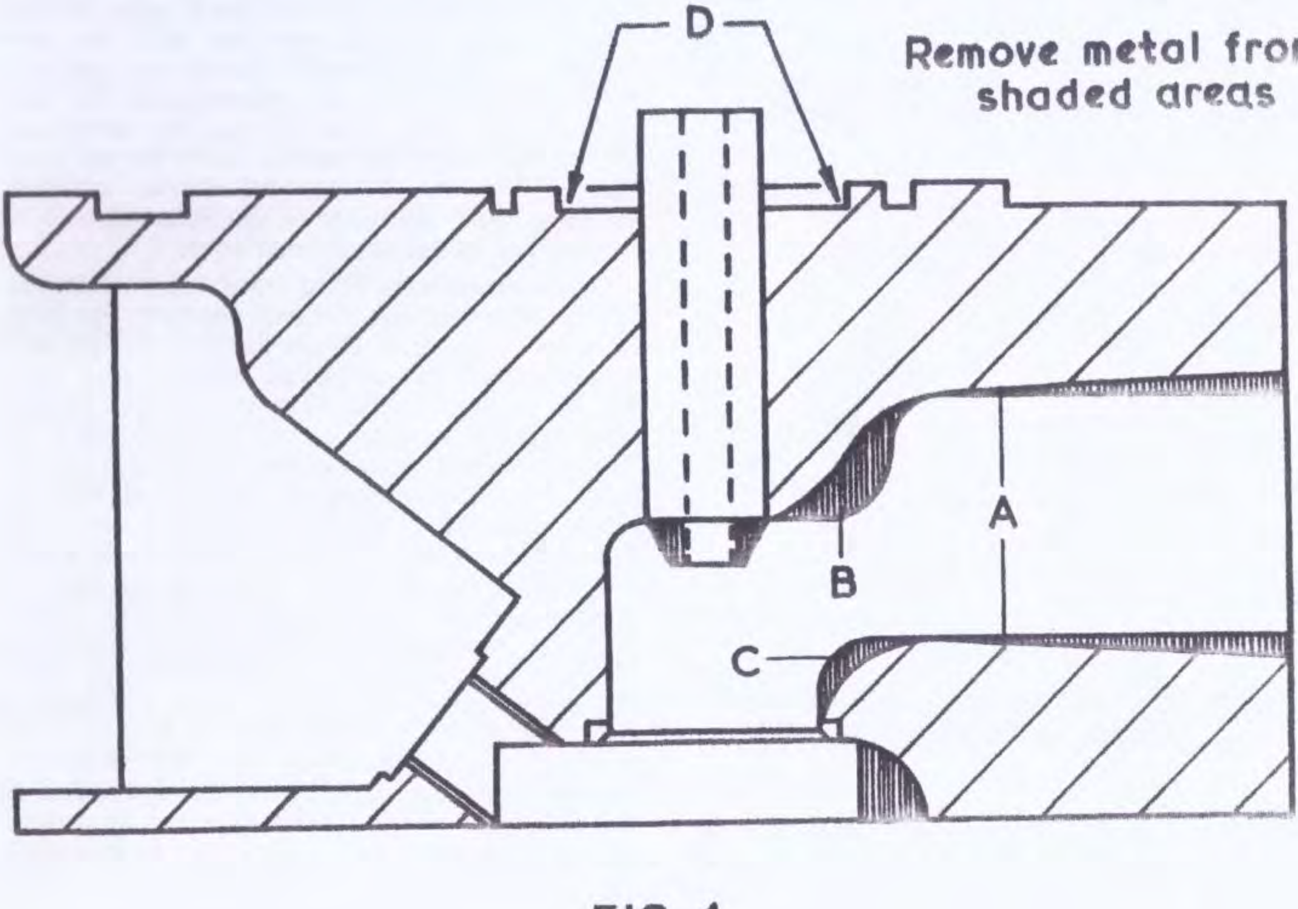


FIG. 4

for determining combustion chamber capacity for a given compression ratio is:

$$\frac{\text{Swept volume} + \text{combustion chamber capacity}}{\text{Combustion chamber capacity}} = \text{Compression ratio}$$

Working from this formula the following table gives the cubic capacity of each chamber for a given compression ratio:

C/R	*Standard Bore*	*Plus ·080in.*
9 to 1	18·6 c.c.	20·0 c.c.
9·5 to 1	17·5 c.c.	18·8 c.c.
10 to 1	16·6 c.c.	17·8 c.c.
10·5 to 1	15·7 c.c.	16·9 c.c.
11 to 1	14·9 c.c.	16·0 c.c.
11·5 to 1	14·0 c.c.	15·3 c.c.
12 to 1	13·3 c.c.	14·2 c.c.

Once a compression ratio has been decided on, a study of the head will determine whether the chosen ratio is feasible. Firstly, casting discrepancies govern the amount of metal removed by surface planing without weakening the head too much, and secondly if the lift at the valve is greater than the depth of the chamber, the liner will have to be relieved. (If you ignore the gasket thickness, any errors which have crept in on measurements, or any over-revving by the odd missed gear change, should not have disastrous results.) Don't forget, however, to modify the chambers before planing, as the more you relieve the chamber, the more you'll have to plane off to get back to the compression ratio. If the steel welch plug at the rear of the head is retained, when the surface is planed, part of the diameter of the plug retaining housing will be removed. This obviously weakens the plug which is then liable to blow out at an inopportune moment. A cure for this is to remove the plug (before planing) and replace with a $\frac{1}{8}$in. aluminium plug. Araldite gives an entirely satisfactory joint and, as long as the inner edge is peened over, a permanent seal is made. Once the head has been planed, run a half-round file around the edge of the chamber to clean off the burrs left by the planer, and thoroughly clean out the swarf from the ports, guides, etc.

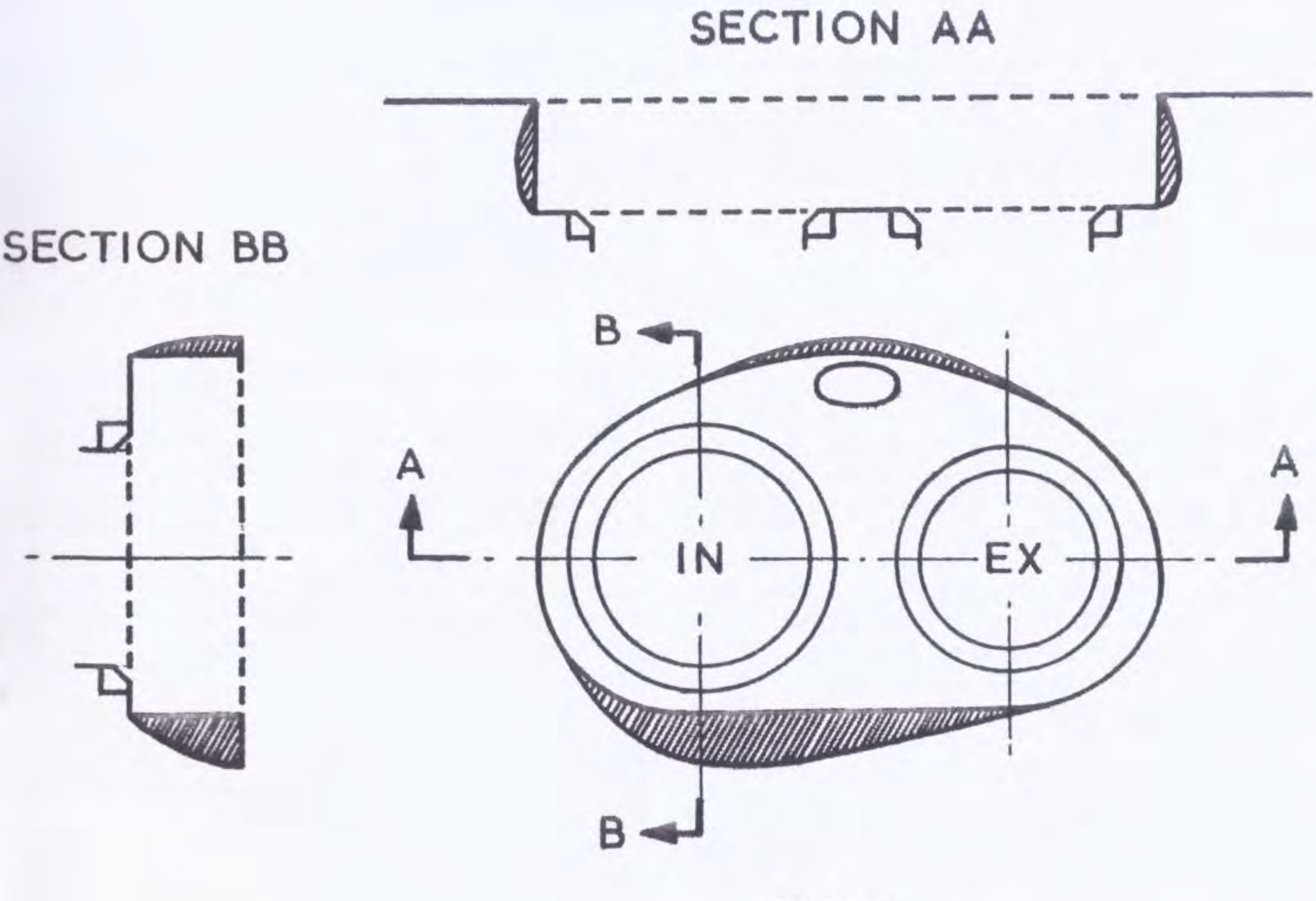


FIG. 6

Converting the 600 c.c. o.h.v. Engine to Full Flow Oil Filter

The original 600 c.c. engine (prior to November, 1967), as mentioned earlier, had a bypass oil filter system. One of the first modifications I considered essential was to convert the system to full flow. This turned out to be comparatively easy and proved entirely satisfactory as long as it was done properly.

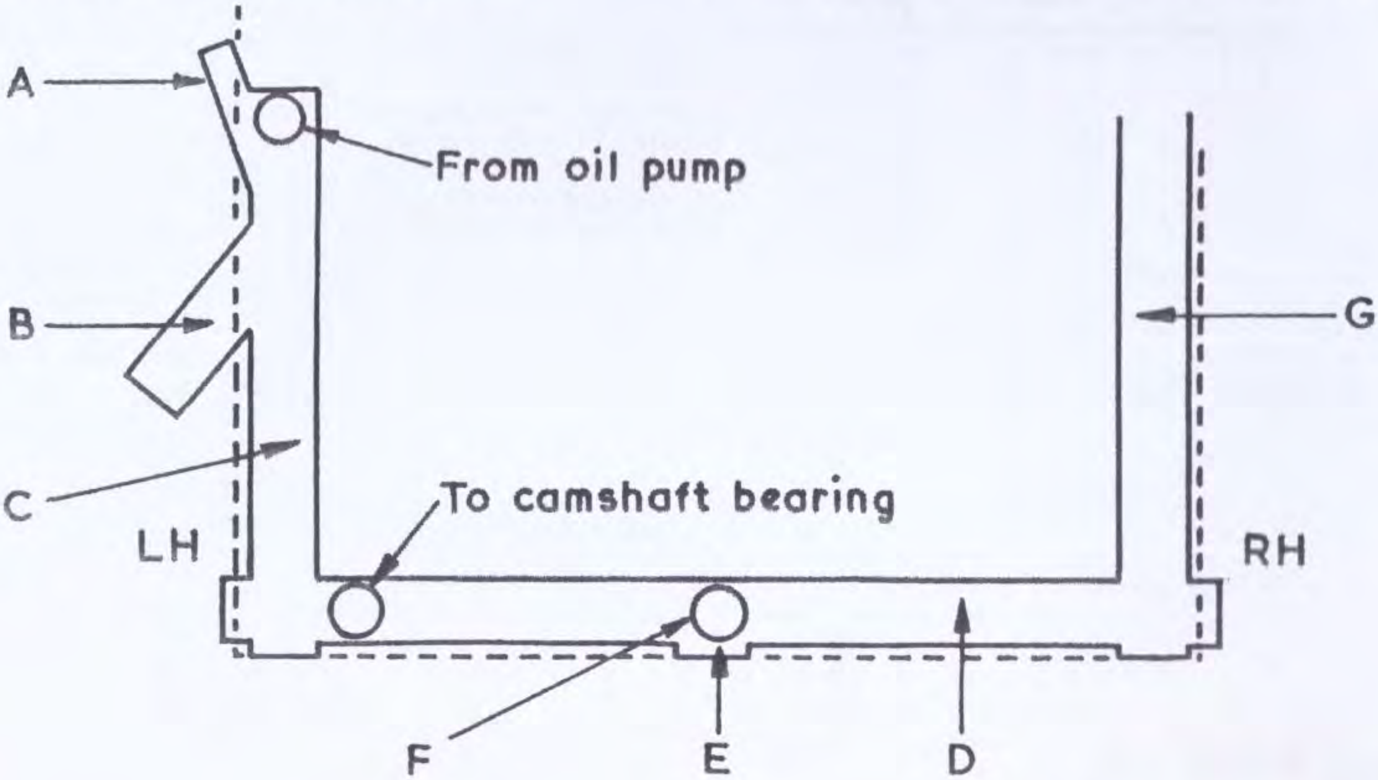


FIG.7

The standard set-up is as follows (see Fig. 7). Oil is picked up from the sump and pumped into an oil gallery on the distributor side of the block. This gallery has three branch drillings: (A) going rearward to the bypass filter mounting, (B) towards the oil pressure gauge, and (C) forward to the front of the block where it connects at a right angle to a gallery (D) running upwards across the face of the block. This supplies the timing chain via a jet (E) and the front main bearing (F). Once again it turns through a right angle and continues to the rear of the engine (G). This gallery (G) has two drillings, feeding downwards through the main bearings to the camshaft. Oil is picked up by the crank via the main bearings and fed through drillings to the big ends. A vertical hole drilled from the rear camshaft bearing feeds the rocker shaft via a passageway cast into the cylinder head. All gallery ends are tapped and plugged with UNF grub screws, which should be removed for cleaning out the galleries.

Step one on the conversion is to make two adaptors to direct the oil out of the block and, later on, back in again. The first adaptor consists of an aluminium block which will be bolted on the original bypass filter mounting. Fig. 8 shows the construction of this block. Fig. 9 shows the inlet adaptor, which is made from a length of 7/16in. 16 SWG mild steel tubing, with a 7/16in. BSF thread one one end. The other end has grooves machined round it to give a better grip for the high pressure hosing. A later alternative to this I used was to have a longer tube and braze a male to male ⅜in. bore oil union on, after counterboring one end 7/16in. to fit over the tube. (The tube must be long enough to clear the engine front plate.) ⅜in. bore tubing can be forced on, with the aid of grease, if the first method is chosen. It is preferable to use two Jubilee clips though as hoses sometimes blow off.

Step two. The drilling at A is very carefully opened out to ⅜in. and the original filter mounting bolt hole plugged with a suitable grub screw, or length of studding, held in with Loctite. The plug is retained by centre popping the edges. It is absolutely essential that this is a very tight fit, or else you'll wonder where your pressure has gone. Four holes are drilled and tapped to mate up with the mounting holes in the adaptor, but care is needed to ensure you don't put one through or near the drilling A. The adaptor is bolted on the block with a suitable gasket between faces; it may sound obvious, but don't forget to cut out the centre of the gasket or else once again you'll wonder where the pressure has gone. The grub screw at the end of gallery D, on the distributor side of the block, is removed and the hole tapped 7/16in. BSF. It is essential to go in at least 2in. with the tap to ensure you seal off the end of gallery C. Once again care is needed when tapping as a loose thread will reduce pressure. I always use a taper tap on jobs like this so that the tube tightens up on the last few threads. The tube is then nutted, and with a few drops of Loctite on the thread screwed into the block, and the nut locked up reasonably tight. A point to remember here is if you use the second alternative for this tube, always prevent the tube twisting when joining the hosing on, either with a spanner on the union or with a mole wrench.

Finally, all galleries and drillings must be thoroughly cleaned out to remove swarf, and the grub screws replaced. (A Woolworth's tea pot spout brush on the end of a length of welding rod is ideal.) It is sometimes easier to remove the camshaft bearings to get to the swarf inevitably trapped behind them.

Just to cater for a personal whim, I re-positioned the pressure gauge union in the rear drilling of gallery G, as I reckon if you have pressure there then you have it everywhere. An Austin 7 type pressure gauge union has a thread very similar to the Relient, i.e. BSP instead of UNF, but with a bit of care will screw in.

The sequence of flow out of the block should now be from the outlet, through the cooler, then the filter, and back into the block. A suitable filter unit can be supplied by Automotive Products, Part No. MF2630. These are available with either an aluminium or steel bowl and alternative flow directions, so decide whether you want right to left, or vice versa, before ordering. It is essential to use a good quality hosing, preferably wire mesh reinforced to at least 250 lb. sq. in. capacity. Any less than 250 lb. sq. in. is not normally suited to high temperatures and will separate internally when hot. Don't use thick wall clear plastic tubing as it becomes too pliable and kinks very easily. Finally, there is no substitute for proper mechanical hose ends; even though Jubilee type clips appear adequate they are liable to blow off at an inopportune moment. Provided the instructions are followed when using the right type, they will always give a secure joint. The inlets and outlets of both the filter unit and oil cooler are of this type, so you might as well use them throughout.

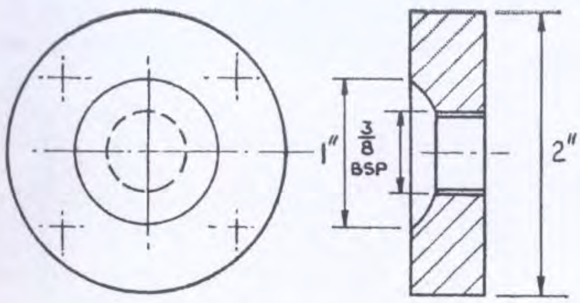


FIG. 8
OUTLET

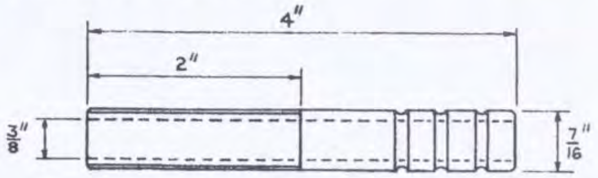
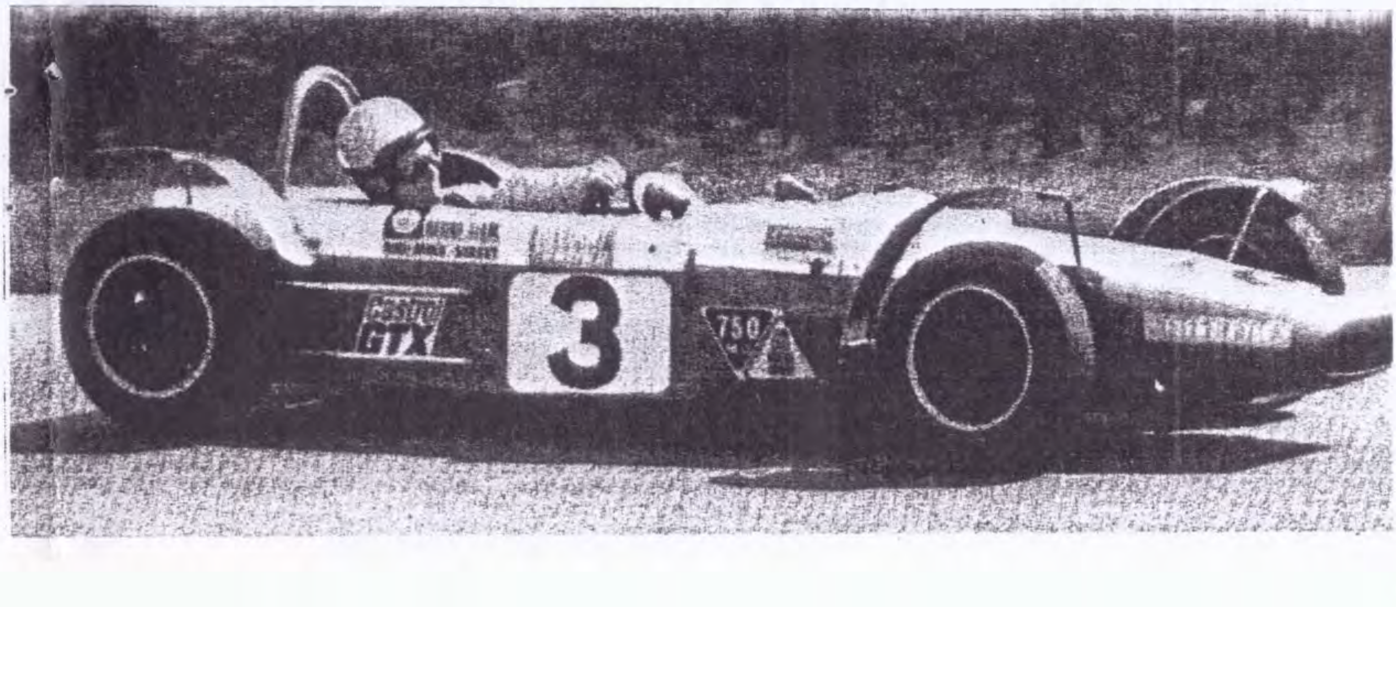


FIG. 9
INLET

Mike Street,1972 Reliant 750 Formula Champion in "D.C. Plus". *Photo by Richcrd Towndraw.*



Dry Sumping

The deciding factor for the original dry sump conversion on Vitesse 3 was to enable the engine to be rotated to 10° from the horizontal. This allowed a body line some eight inches lower than the car would have been with a vertical engine. The fact that I had a series of misfortunes originally were not discouraging and, once cured, convinced me that the advantages gained in reliability were worth the effort. When Vitesse 3 was finally sold it was without the dry sump equipment which was passed on to David Newman for a few of the crinkly ones. As proved by David, it has worked. The advantages are, if it's done right, a complete removal of the oil-surge problem, more oil can be carried, hence the oil runs cooler and less liable to breakdown, and a reduction in crankcase pressure thereby decreasing the amount of oil getting past piston rings.

Basically the scavenge pump should pass at least twice the capacity of the pressure pump as the extracted oil is larger in volume due to aeration; the tank should be of a capacity half as much again as the oil carried, for the same reason; the scavenge pick-up trough should be designed to remove the oil as quickly and efficiently as possible; and the crankcase should be allowed to breathe adequately. Whilst I was "playing about" with dry sumping more than one method of mounting the pumps was tried, but I will only describe the final system. As there are no combined pumps designed to fit directly on to a Reliant, the one used had to be very much a one-off modification. This was a converted Ambica-produced combined pressure/scavenge pump, originally for a Ford engine. (The original system retained the standard Reliant pressure pump, with a separate scavenge, mounted and driven independently. The scavenge worked alright but the pressure pump, as it was designed to be in the sump, wasn't oil tight. Obviously, for an internal pump this does not matter but, mounted outside, oil goes everywhere, hence a change of ideas.)

The end result was a combined pump mounted on the timing case, driven direct from the end of the camshaft. The water pump and crankshaft pulleys were modified to take a ⅜in. pitch tooth belt, long enough to drive a third pulley driving the distributor mounted on an extension of the front engine plate. This then allowed the rev counter drive to be taken from the original distributor drive. David Newman has modified this system by keeping the distributor in its original position and driving the rev counter via the tooth belt. One of the benefits of a front mounted pump is that the skew gear on the camshaft is relieved of the task of driving the oil pump. As a number of skew gears on the cam have failed in the past, probably due to bumping the oil pressure up too much, it certainly removes a potential source of unreliability.

Now for an outline of the work involved. The pump mounting to the timing case must be rigid, and I repeat *must* be rigid. Short of casting a new cover there is only one way. This must be done exactly as described otherwise you are wasting your time. The casing is firstly dowelled to the block to ensure the same assembly every time. A small centre punch is turned up to fit in the hole in the front end of the camshaft. With the cam in position, without its front retaining collar, and the timing cover bolted on, from inside the block move the camshaft forward in its bearings and, by rotating, mark the inner face of the casing. The casing is removed and a pilot hole drilled through the centre mark. By mounting the casing on a lathe by a face plate, the pilot hole is opened up to 1¼in. Reverse the case on the face plate and, using the crank pulley hole as a centre, from the outside diameter of the pulley hole face off the front of the casing (very lightly as it's very thin) to remove the original timing mark. An aluminium or dural block at least 1in. thick is then shaped as shown in Fig. 10, with a hole bored to take the spigot

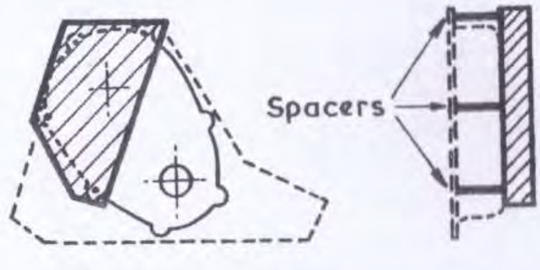


FIG. 10
PUMP MOUNTING PLATE AND SPACERS

of the oil pump. A locating step is machined on the rear of the block to fit the 1¼in. hole bored in the timing case. The block is mounted on to the case by four ¼in. bolts or Allen cap screws from the inside. The position of these bolts must be carefully selected to ensure clearance over the cam and crank pulleys. Araldite between the case and mounting block gives an oil-tight seal. As seen in the diagram, the block is larger than the front of the cover to enable longer bolts than standard to be used. Spacers of accurate length must be used between the block and lugs on the timing cover. If spacers aren't used the action of tightening the assembly to the cylinder block cracks the timing cover. I know—it has happened! The actual mounting of the pump to the dual block depends, of course, on the pump used; they are, however, identical in the bolt hole positions, which can now be drilled and tapped in the mounting block. (I purposely omitted a size when mentioning the hole through the block as obviously it's bored to the pump you use.) Pumps of the Holbay, Rowland, etc., type, as used in side-mounted position on Ford engines, are satisfactory, but remember to position the pump to enable you to connect the hoses, i.e. not directly across the crank pulley. You will probably find the drive shaft of the pump is too long and fouls the camshaft pulley; this is, however, no problem to shorten. It needs to be just clear of the pulley with a tongue milled on the end at least 5/16in. wide. The corners of the tongue must be radiused to relieve the stress. A rectangular plate of 3/16in. thickness is drilled to take the two camshaft pulley bolts, with the corresponding tongue slot cut centrally. This must be a reasonable slack slot to allow the shaft to take up misalignment. The original bolts won't be long enough unless you turn off some of the head depth from the back of the head. Or, alternatively, use longer shoulder bolts, but thin down the heads to clear the timing case.

Alternative methods of driving are to slot the pump shaft and bolt a plate with a central spigot to the camshaft pulley, or slot the pump shaft and the plate and connect with a separate coupling. A smaller crankshaft pulley is now essential otherwise you'll foul the mounting plate; this to my mind is not a bad thing anyway, as it reduces the speed of the water pump. In standard form they run at about 1 to 1 which is probably too much at revs over 7,000, and liable to cavitate, giving you cooling problems. When using a smaller pulley it should be of the tooth belt type, as should the water pump pulley. A most helpful firm are Aurora Gears of Sheffield, who supply aluminium pulleys and the appropriate belts at quite reasonable prices. Both the crank and water pump pulleys are modified by turning off the old belt flanges, boring out the new aluminium pulleys and shrinking them on, locked in position by grub screws at the joint. It is essential that at least one of the pulleys has side flanges to prevent the belt riding off. If the distributor remains in its original position, and you use a mechanical rev counter, a third pulley can be run, through a couple of roller bearings mounted in a housing on the front engine plate, to drive the rev. counter gearbox. Don't forget the gearbox ratio though when ordering your pulleys.

Now that the pump has been mounted, all

The author in Vitesse 3 with the "horizontal" engine.
(Notice how low the bonnet is compared with 10in. diameter wheels.)

that is left is to arrange where the oil is to be pumped into the engine, and to modify the sump to scavenge the oil away. All current combined pumps have built-in pressure release valves which solves one problem. If the inlet adaptor is constructed as in the previous chapter, on converting to full flow it effectively blanks off the gallery with the original pressure release valve. The valve can be left in situ, it doesn't do anything any more but at least it blocks the hole up. Likewise the holes in the original filter unit mounting should be blanked off to prevent oil being blown out of the crankcase. I won't go into details of the pressure release valve which is necessary if you don't have one on the pump. I'm assuming that if you are dry sumping you'll make sure you've got the right pump to start with.

A good example of a modified sump, and one I admit I copied, is the Holbay Ford sump. The object is to get as much oil as quickly as possible to the lowest part of the sump, and to prevent it being thrown away again by the turbulence set up by the crankshaft. The Holbay 1-litre type has a central trough of about $1\frac{1}{4}$in. by $1\frac{1}{4}$in. running the length of the sump, with the pick-up in the middle. This is taken from the side of the trough, I'm not sure that it matters from which side, and baffled. One factor that seems to be important is that the internal baffle plate is sealed on either end to the sump pan, and the gaps are kept to a minimum. Fig. 11 shows the design and construction.

Finally, a note on the tank itself. It should be baffled internally to separate the air from the oil. This is normally accomplished by a series of drilled horizontal baffle plates which also help to prevent the oil surging away from the pick-up. The oil must be taken from the bottom of the tank and fed into the top to ensure complete de-aeration. A separate breather pipe is essential from the tank unless a ventilated cap is fitted. Hosings and fittings, etc., must be of good quality for obvious reasons, as explained in an earlier chapter.

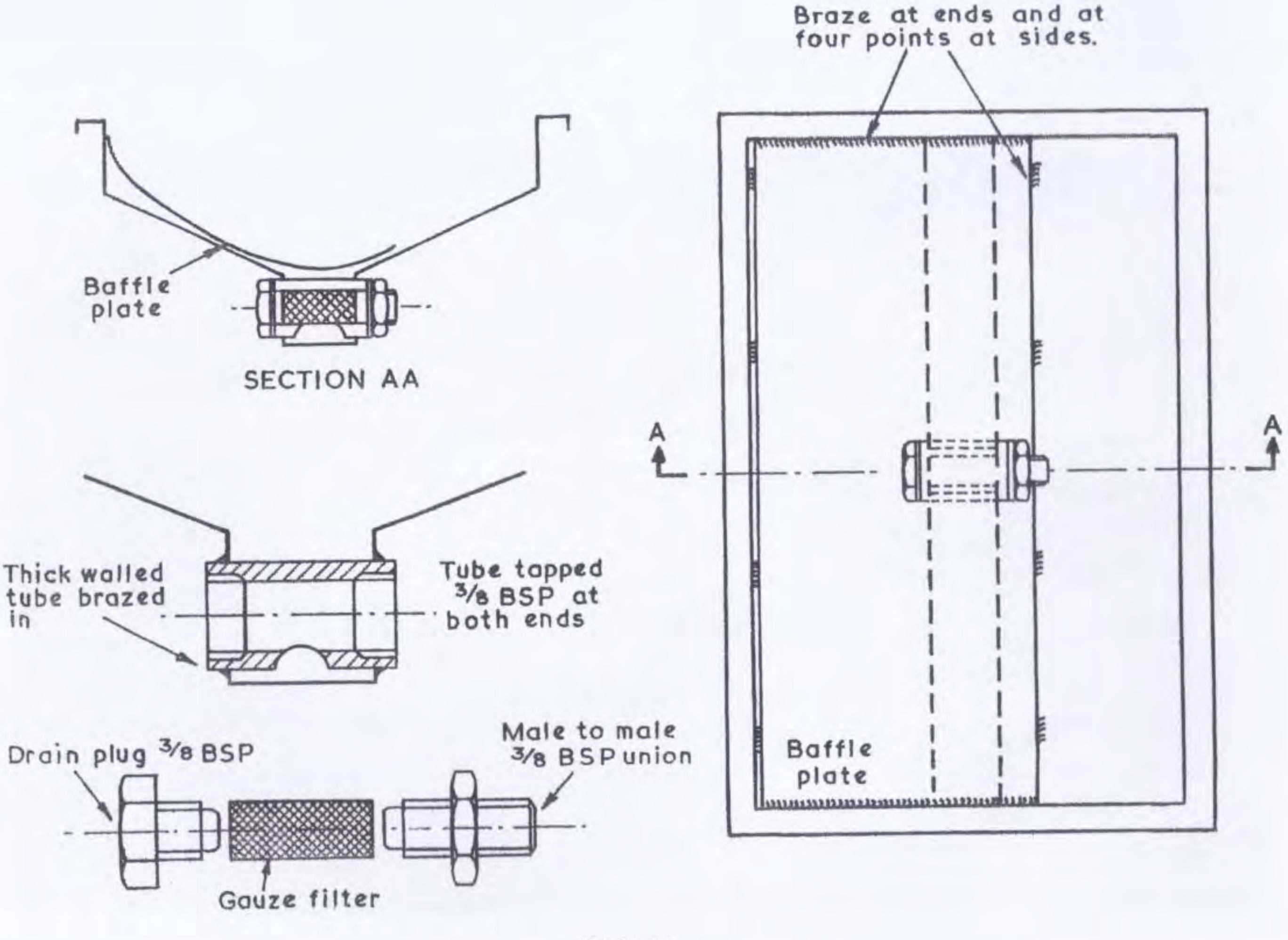


FIG. 11
SUMP

Appendices

CONVERSION OF 700 cc. ENGINE TO 600 c.c.

To convert a 700 c.c. engine to 600 c.c. it is only necessary to change the liners and pistons. (*Note:* Liners are special, not existing 600 c.c.)

Items required: Special liners Reliant Part 10939
Pistons Reliant Part 9491 (standard 600 c.c. pistons)

The liners should be sealed in the cylinder block using HYLOMAR SQ 32/M sealant.

Those engine builders who have recently bought, or intend using, the later type 700 crankshaft will find the rear oil seal differs from the 600 type. The later crank can be used in conjunction with a 700 type housing and lip seal, part nos. and prices as follows, which can be obtained from any Reliant main dealer: Housing 20242 at 52p; Seal 20241 at 43p

PRINCIPAL ENGINE CHANGES

Engine numbers Regal	Rebel	Approx. date	Change	Major items affected
87367			Distributor lowered	Block
88758			Gudgeon pins enlarged to 9/16in. diam.	Pistons, little end bushes
91700		Mar. 66	Oil supply to rockers	Block, head, camshaft (see following explanation)
93860			Crank pulley bolt now 3/8in. UNF	Crank
101090			Three extra cylinder head studs added	Block, head, gasket
107142	700001	Nov. 67	TW7B—Full flow oil filter and 30 IZ Zenith carburettor	Block, inlet manifold, carburettor, oil filter
115915	700491	June/ Aug. 68	Start of 700 c.c. Earthing system changed to negative. Distributor rotation changed	Dynamo, camshaft, distributor, oil pump. Drive gear
117572			Water outlet branch changed	Water outlet branch
129628	700904		Timing chain tensioner fitted	Timing chain cover
136204	700981		Improved water pump	Water pump—interchangeable with previous
141460	701041		Improved rear crank sealing	Crankshaft, oil seal, rear cover and gasket
142300	701052		Sealed engine—crankcase ventilation system changed	Air cleaner, oil filler, block modified. Moved dipstick forward to front of block

CYLINDER BLOCK AND CAMSHAFT MODIFICATIONS

The Reliant 600 c.c. engine has undergone various modifications to both the cylinder head and the camshaft. The following notes will clarify the situation, with special reference to interchangeability of components.

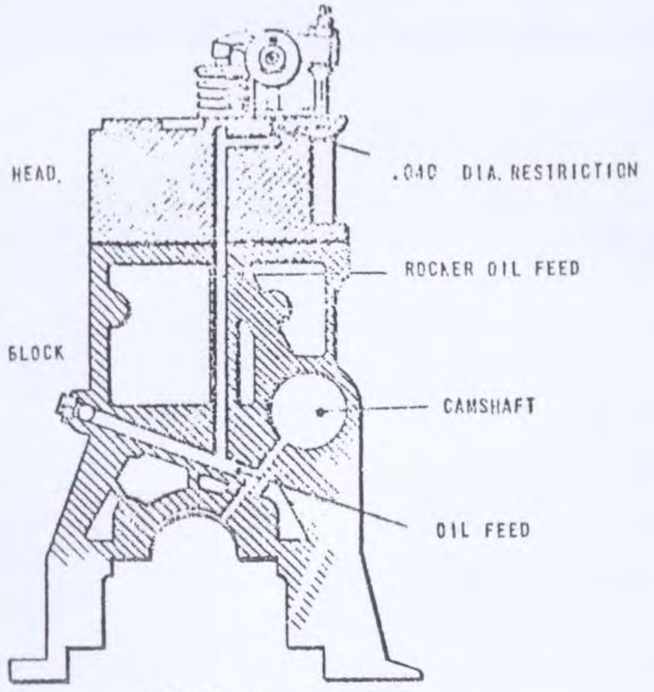
The block has been altered in three stages to improve lubrication to the valve rocker shaft.

Stage One: The original block fed oil to the rocker shaft by an independent drilling to the cylinder head, and an oil restriction hole in the cylinder head prevented over-lubrication (see illustration). Current production camshafts, and bushes, supplied by Reliants can be interchanged in these blocks, should older components not be available.

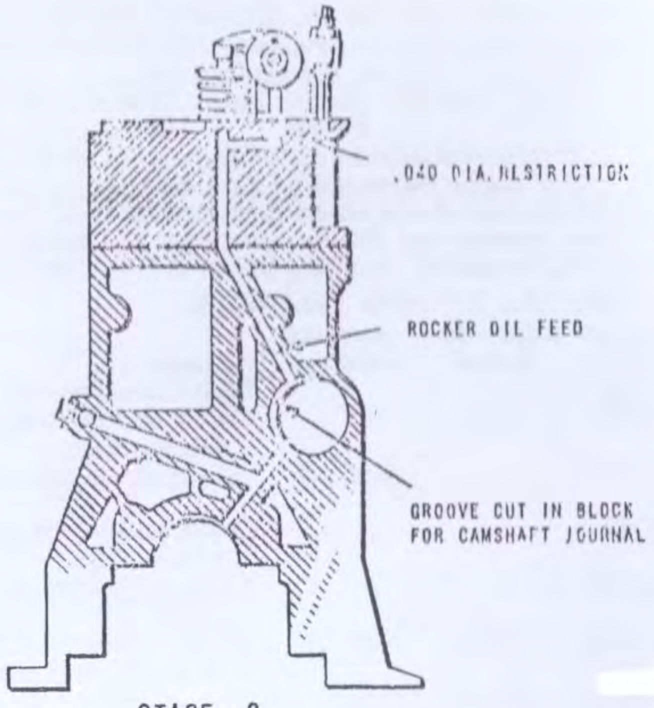
Stage Two: The first change to the lubrication system was in replacing the independent channel to the head by an angled oilway from the rear camshaft journal to the cylinder head, the oil restriction hole in the head still being used. The oil feed was supplied by a groove cut in the bore for the rear camshaft journal (see illustration). The current production camshaft and bush can again be safely used in these Stage Two modified blocks.

Stage Three: In current production engines the rocker shaft oil feed is supplied by a groove cut in the rear camshaft journal with two holes drilled in the camshaft bush giving a controlled intermittent oil feed when the groove bridges the two holes. The drilled angled oilway to the cylinder head is as used in Stage Two. The head has been modified in as much as the oil restriction is no longer required and the restriction hole is replaced by an $\frac{1}{8}$in. diameter hole (see illustration). For replacement, *only the latest* camshaft with the groove and the drilled camshaft bush should be used. An old cylinder head could be used providing the oil restriction hole is drilled out to $\frac{1}{8}$in. diameter.

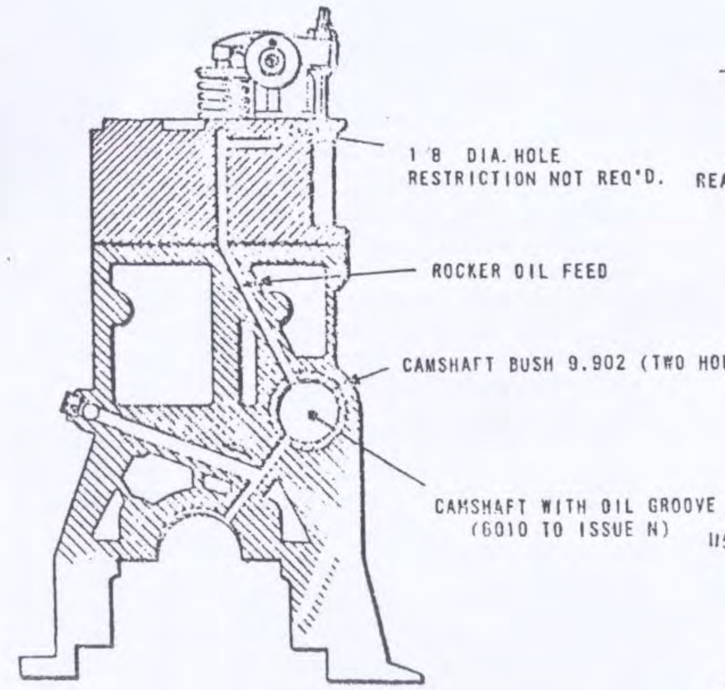
It will be seen that regardless of the cylinder block both the latest camshaft, with the groove and the latest bushes, with two holes, can be safely used.



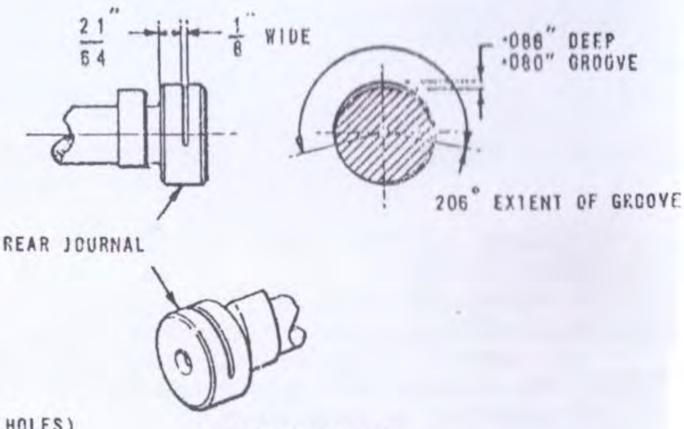
STAGE 1



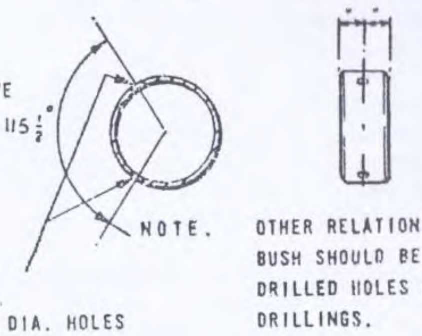
STAGE 2



STAGE 3

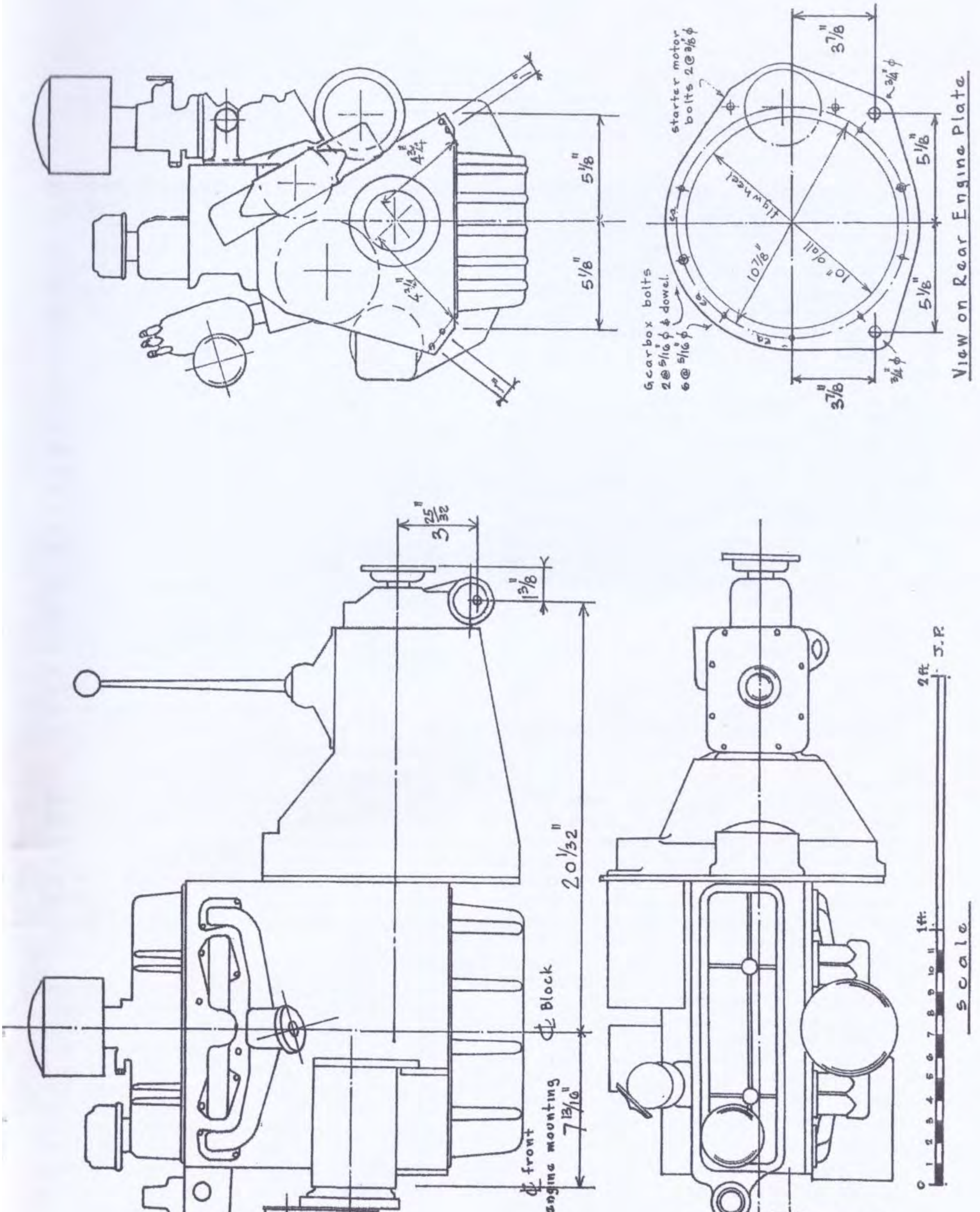


CAMSHAFT GROOVE



OTHER RELATIONSHIPS ARE UNIMPORTANT
BUSH SHOULD BE INSERTED SO THAT THE
DRILLED HOLES LINE UP WITH THE BLOCK
DRILLINGS.

CAMSHAFT BUSH


View on Rear Engine Plate
starter motor bolts 2@3/8"ϕ
Gearbox bolts 2@5/16"ϕ & dowel. 6@5/16"ϕ
flywheel
10 7/8"
10" o/all
5 1/8"
5 1/8"
3 7/8"
3 7/8"
3/4"ϕ
3/4"ϕ
4 3/4"
4 3/4"
5 1/8"
5 1/8"
3 25/32"
1 3/8"
20 1/32"
℄ Block
℄ front engine mounting
7 13/16"
Scale
1 ft.
2 ft.
J.R.

Reliant 750 Formula — 1972

The following regulations apply to the 1972 season. Intending competitors reading them after this time should apply to the Club Secretary for the current regulations as they are re-considered and modified, where necessary, at the end of each season.

The 750 Formula for sports racing cars was devised in 1949 to make an equitable base for scratch racing amongst those of limited means, anxious to enter into and enjoy motor racing. Cars are based, as far as the main elements are concerned, upon simple, sturdy and easily obtained components so that the cost of racing is kept to a minimum, yet the amateur builder and engine tuner is given ample scope to develop his skills.

An annual National Championship is run by the 750 Motor Club Ltd. for cars complying with the 750 Formula. This consists of about twenty races at circuits throughout the country, from which the best eight results count. In the event of the championship being level after the best eight results, then a ninth result is included, and so on until a winner is decided. Full details of this championship are available from the Club Secretary or the Director responsible for 750 Formula Affairs.

1. Cars
The Formula requires two-seater sports cars, front- or rear-engined, open or closed, complying with the undermentioned regulations and with the R.A.C. vehicle regulations, except where those are modified by the following regulations.

2. Chassis
The chassis shall have as the main longitudinals two 2 inch by 2 inch 16 swg square steel tubes into which the suspension loads shall be fed. If ¼ elliptic rear springs are used, the tubes shall be of a minimum continuous length of 52 inches. With any other types of suspension they must extend to within 6 inches of the vertical planes through front and rear wheel centres. Lightening holes must be on the centre line of the faces, no more than 1 inch in diameter, and not less than 1½ inches from centre to centre. Cars constructed prior to 1971 and registered with the 750 Motor Club are permitted to use Austin 7 side-members in lieu of 2 inch by 2 inch tubes, in accordance with earlier regulations (see Note E).

3. Engines
The engine must be (*a*) Reliant OHV, (*b*) Reliant 747 c.c. Side Valve, or (*c*) 747 c.c. Side Valve Austin 7. If the Reliant OHV engine is used, it must have a standard cylinder head casting and standard cylinder block/crankcase. The standard stoke of 2·4 inches must not be altered, nor must the bore exceed 2·28 inches giving a capacity of 642 c.c. Pressure charging and fuel injection are not allowed. The camshaft must remain in the manufacturer's original position and operate the pushrods, but the material construction and camshaft lobe profile may be altered. There must be not more than two valves per cylinder, and the valves must remain parallel to each other. There must be, between the carburettor flange and inlet manifold, a single restrictor with an internal diameter of not more than 22 mm made of a rigid, non-ferrous, non-porous metal inserted in such a manner that all the mixture passes through it. If removable, the carburettor choke may form the restrictor, but no allowance will be made for any restriction caused by jet carriers, etc. (see Note A). The use of slide throttles in which the slide moves out of the carburettor body and is exposed is strongly deprecated on safety grounds and will be banned in 1973. There shall be no restrictions on either of the side valve units, other than that the capacity shall not exceed 803 c.c. and that OHV and OHC conversions are not allowed.

4. Transmission
The gearbox must include a reverse gear capable of being engaged by the driver in the normal seated position, and contain not more than four forward gears. A proprietary bevel driven live rear axle must be used to drive the rear wheels. Torque biasing or limited slip differentials will not be allowed.

5. Bodywork
As R.A.C. Vehicle Regulations, except that the cockpit opening may be encroached upon by structural members provided that it is still possible to seat the passenger and that such members extend from the body side to the centre of the car or to brace the roll over bar. The passenger space, measured at floor level, must be at least 11 inches wide at the rear of the cockpit and at least 36 inches in length to the front of the foot well, which must be at least 6 inches wide. The passenger space must remain clear of any obstruction other than a fire extinguisher.

6. Roll over Bar
An effective roll over bar must be fitted of a height not less than 5 cm at its top edge above the helmet when the driver is in a normal seated position. It must also be wide enough, at the appropriate height, to be wider than the driver's shoulder and constructed of tubing at least 35 mm outside diameter with a wall thickness of at least 2 mm. A $\frac{1}{4}$ inch hole should be drilled on the underside for checking this thickness. The top of the bar shall be a straight or curved form and not tubes meeting in an inverted V, and the bar must be effectively braced to a structural member.

7. Electrical
A starter and battery must be carried, capable of performing repetitive starts. No other electrical equipment need be carried.

8. General
This Formula was devised for the benefit of the amateur driver, constructor and tuner with limited resources. The 750 Motor Club Board therefore reserves the right, at all times, to reject any car which it considers represents an attempt to defeat the spirit of these regulations even though it complies with the letter of them. This also applies to expensive production cars, or cars developed with a high percentage of costly proprietary components. Professional maintenance of 750 Formula cars is not permitted.

NOTES

The following notes do not qualify the mandatory constructional requirements above, but explain the thinking behind them and the way in which subjective requirements may be interpreted.

A. Inlet Manifold Restrictor
The Board reserves the right to modify the size of the orifice by publishing a notice in the 750 Bulletin, such a change to become effective not less than 21 days after the publication date of the issue containing the notice.

B. General
Whilst it is accepted that much work is necessary to modify engines and build chassis, etc., the term "professionally maintained" refers to regular preparation by a professional, other than the competitor, on a commercial basis and this is not allowed.
All cars will be subject to normal pre-race scrutiny for safety and eligibility. In addition, periodic checks of restrictor orifice sizes and eligibility in other directions may be expected, either before or after a race.

C. Advertising
Individual advertising decals in accordance with R.A.C. requirements may be carried only in respect of the following:

1. Fuels and oils used by the competitor.
2. Components and accessories used in the construction of the car (i.e. shock absorbers, tyres, etc.).
3. Technical services, provided that these do not imply professional maintenance as defined in paragraph 8.

In addition, competitors may be required to carry decals in respect of group advertising negotiated by the Club for the benefit of all competitors.

D. Standard of Preparation
Competitors in races under 750 Formula must realise that they are carrying the banner of the 750 Motor Club before the public. A high standard of preparation is therefore essential and will be insisted upon. It must be appreciated that the decision whether or not Invitation Formula Events are provided rests entirely with the promoting Club, whose policies the 750 Motor Club cannot influence, but whose good offices are relied upon to provide events at their meetings.

E. Existing Cars
As a result of substantial simplification of the Formula by conforming more closely to R.A.C. Vehicle Regulations for bodywork and by requiring that R.A.C. recommendations for roll over bars be followed some existing cars, and cars under construction, may infringe these 1972 regulations in minor respects. If, in the view of the Club's Chief Scrutineer or Director responsible for the 750 Formula, these cars are not readily modifiable, such cars may be permitted to continue to compete if registered in writing with the 750 Motor Club Director for 750 Formula Affairs *before* 1st January, 1972.

F. Infringement of Regulations
Complaints concerning any possible infringements should be made in writing to the Director for 750 Formula Affairs, when matters will be investigated and action taken if deemed necessary.
It must be understood that the responsibility for ensuring that a car complies with these regulations rests entirely on the competitor, and if he has *any* doubts at all a written request for a confirmation of eligibility must be made to either the Club's Chief Scrutineer or the Director for 750 Formula Affairs.

G. Addresses
750 *M.C. Director for* 750 *Formula Affairs:* Bryan Clayton, 39 Cannon Grove, Fetcham, Leatherhead, Surrey. *Tel.:* Leatherhead 74848.
General Secretary for 750 *Motor Club:* Dave W. Bradley, 16 Woodstock Road, Witney, Oxon, OX8 6DT. *Tel.:* Witney 2285.

Reliant Parts Distributors Offering 25% Discount

ON PRODUCTION OF 750 M.C. MEMBERSHIP CARD

B. Coles Limited
Birmingham.
Tel.: 021-772 5916.

Roy Peplow and Company
Wednesbury.
Tel.: 021-556 0100.

West (Lincoln) Limited
High Street, Lincoln.
Tel.: 0522 21262.

Dixon of Sawbridgeworth
Herts.
Tel.: Bishops Stortford 72072.

Motor Imports Company Ltd.
17a Seely Road, Tooting, S.W.17.
Tel.: 01-672 2062.

Glanfield Lawrence Ltd.
Portsmouth.
Tel.: Portsmouth 27551.

Car Distributors Ltd.
Cardiff.
Tel.: 0222 30022.

J. A. Blonden (Motors) Ltd.
Rendle Street, Plymouth.
Tel.: Plymouth 68451.

Waldot Service Station
(W. Dungworth Limited)
Tel.: 0742 348807.

Kings Motors (Oxford) Limited
Chester Road, Manchester.
Tel.: 061-865 1151.

Bob Sergent Limited
Liverpool.
Tel.: 051-236 8327.

Harvey & Company (Leeds) Limited
Leeds.
Tel.: 24986.

W. J. McCrum Ltd.
Belfast.
Tel.: Belfast 23065/25587.

What The Papers Say . . .

"It is twenty-two years since the 750 formula was first devised and on present showing it hasn't been a day too much. The formula seems destined to go on for ever. And why not? With cars costing less than £300 and a sensibly drawn up set of rules which give ample scope for the inventive engineer, it is surely the epitome of cheap motor racing and as such deserves to succeed."

Motoring News, July, 1970.

"The 750 cars turned out in force to make this the best supported race of the day . . ."

Motoring News, September, 1970.

"*The big* 750 *formula field provided one of the best races of the day.*"

Autosport, October, 1971.

"*This meeting was the opening round of the longest established Championships in British Club racing, those for* 750 *and* 1200 *Formulae, and the* 750 *entry warranted two heats and a final.*"

Motoring News, April, 1970.

"What's the cheapest way to go motor racing? Well apart from racing your road car, there's no doubt that the 750 formula car is the ABSOLUTE cheapest."

Hot Car, October, 1968.

". . . the 750 Motor Club was formed 30 years ago and has for ever after given a true meaning to low cost motor racing."

Motor, November, 1969.

750 MOTOR CLUB

Leaders in Low Cost Motor Sport

General Secretary: David Bradley
16 WOODSTOCK ROAD, WITNEY, OXON, OX8 6DT — Tel.: Witney 2285

The 750 Motor Club was founded in 1939 with the aim of providing opportunities for enthusiasts of limited means to take part in motor sporting activities:

Throughout the years the Club has developed on a national basis, and there are now some two dozen regional centres in the British Isles, each organising sporting and social events for local members.

The 750 Club is best known for low-cost racing and trials Formulae. **The 750 Formula** for sports cars was devised in 1949 and is the most successful form of truly low-cost racing in the history of motor sport. Cars can be built from modern components for between £150 and £300, and achieve maximum speeds of over 100 m.p.h., powered by Reliant engines.

The 1200 Formula was introduced in 1953 as a progressive step from 750 Formula, and in its present form provides Ford-powered racing for "specials", and "kit cars" such as Lotus 7's and U2's while the **New Formula 4,** adopted in 1970, provides another logical step to low-cost single-seater racing.

These Formulae have always encouraged amateur engine tuning and chassis and suspension development, and the Club is proud that so many well-known figures in the motoring world have participated in 750 Club activities as "special builders".

Such men as COLIN CHAPMAN of Lotus, Formula 1 *car designers LEN TERRY, ERIC BROADLEY, and the late DERRICK WHITE, and specialist car manufacturers JEM MARSH (MARCOS) and DEREK BENNETT (CHEVRON), all started motor racing as 750 Club members, in* 750 *Formula or* 1200 *Formula "specials".*

750 *members have driven in Grand Prix races, designed "Indianapolis* 500*" and "Le Mans 24-Hour" race winners, and are to be found at the forefront in all spheres of motor sport—why not join them by becoming a member of this remarkable Club?*

In addition to promoting **750 Formula, 1200 Formula and Formula 4 racing** within **National Championship** series, the 750 Club organises **Race Meetings at major British circuits,** and receives invitations from other Clubs for members to take part in literally hundreds of race meetings, hill climbs, sprints, autocrosses, driving tests, rallies and trials. Non-competing members can join the **Marshals Register** and assist in the organisation of events. Premier event on the 750 Club Calendar is the **NATIONAL 6 HOUR RELAY RACE,** described as the "Le Mans of British Club racing"; a unique endurance race for teams of sports and saloon cars of all types.

In the winter the focus is on trials—for **750 FORMULA** and **NATIONAL TRIALS FORMULA** "mud plugging" cars, and for production cars, with a full season of events in various parts of the country.

Vintage enthusiasts are catered for by the very active **AUSTIN 7 REGISTER,** which organises rallies and social events and is affiliated to the Association of Austin 7 Clubs.

MEMBERSHIP APPLICATION FORM (block capitals, please)

Name (Mr. Mrs. Miss) ....

Address ....

.... **Telephone No.**....................................

	£		£
Entrance Fee	0·50	Car Badge	1·75
Subscription for year	3·00	Lapel Badge	0·20
Associate Membership		Club Tie	1·00
(wife and close relatives)	0·50	Panel Transfers (Large)	0·13
Junior Membership	1·00	Panel Transfers (Small)	0·06
		Design for Competition	1·00
£		Reliant Engine Tuning	0·50
		Car Key Ring	0·30
		Anorak	5·50
		£	

Total Remittance payable to 750 MOTOR CLUB LTD. £
(Prices current at the time of printing and subject to alteration).

I, the undersigned, hereby apply for membership of the Seven Fifty Motor Club Ltd. and agree to be bound by the requirements of the Memorandum and Articles of Association of the Company (of which Clause 7 reads: "Every member of the Club undertakes to contribute to the assets of the Club in the event of its being wound up while he is a member or within one year afterwards, for the payment of the debts and liabilities of the Club contracted before he ceases to be a member, and the costs, charges and expenses of winding-up, and for the adjustment of the rights of the contributors among themselves, such amount as may be required not exceeding one pound sterling") and of the Company's Act, 1948. I acknowledge and accept any liabilities placed upon and under the aforesaid Memorandum and Articles of Association.

Usual Signature .... *Date* ....

In the case of a proposed membership under the age of 18 years, the following further declaration must be signed by his or her parent or guardian.

As parent/guardian of the afore-mentioned applicant for membership, I hereby guarantee to discharge any liabilities incurred by him/her under the provisions of the Memorandum and Articles of Association of the Seven Fifty Motor Club Ltd.

Signed ....

Address ....

....

Name in Block Capitals ....

Date ....

Apart from the monthly Club meetings held in London, there are various Centres and Groups throughout the country, each with their individual activities. Please put a cross by the Centre or Group in which you are interested.

SOUTHERN CENTRE
Bramshaw, Hants
ESSEX CENTRE
Wickford
AUSTIN SEVEN REGISTER
OXFORD GROUP
Witney.
SHEFFIELD GROUP
Sheffield
BROOKLANDS AREA GROUP
Chobham
SOUTH LONDON CENTRE
London, S.E.27

MIDLAND CENTRE
Coleshill
SOUTH DOWNS CENTRE
Petersfield
N.W. CENTRE
Manchester
LONDON SPECIAL
BUILDERS' GROUP
Battersea
NORTH HERTS CENTRE
Hitchin
WESTERN CENTRE
Whitminster, Glos.

EAST MIDLAND CENTRE
Loughborough
DEVON GROUP
Kennford, Exeter
TUNBRIDGE WELLS CENTRE
Lamberhurst
READING CENTRE
Caversham
NORFOLK CENTRE
NORTH WEST LONDON GROUP
Northolt
MERSEYSIDE GROUP
Cheshire

DAVID NEWMAN (CAMSHAFTS) & Co.

FARNBOROUGH WAY, FARNBOROUGH, KENT TELEPHONE: FARNBOROUGH 57109

Engine

712 camshaft. Full race Reliant. 52 92, 92 52 timing. ·303 valve lift. £12 exchange. Competition discount on this items. Contact for details.

Race inlet manifold for side or downdraught application, fully machined in LM4. £8 outright.

Aluminium rocker cover in LM4, fully machined, complete with screw typ filler cap. £4·75 outright.

Rocker pillars. Machined from EN8, complete with shaft clamping pins. £4·75 per set of 4.

Steel main bearing straps. Machined from EN8, complete with 60 ton Allen bolts (customer's cap required for machining). £4·75 per set of 3, including machining caps.

Cylinder head. Basic race, fully ported with combustion chambers reshaped, surfaced and valve seats recut. £15 exchange.

Cylinder head. Full race, fully ported with combustion chambers reshaped, fitted with 1·05 inlet valves. £25 exchange.

Piston. Plus 80 thou, solid skirt by Pistons (Coventry) Ltd. £15 outright.

Liners bored and honed 80 thou oversize. £5 exchange.

Flywheel lightening. £2·50 exchange.

Close ratio gears for Reliant gearbox

Basic race set. Uprated 1st, 2nd and 3rd (layshaft gear cluster and spigot shaft required). £19·50 exchange.

Super race set. Uprated 1st and 2nd, downrated 3rd (layshaft gear cluster, 3rd gear from mainshaft and spigot shaft required). £29·50 exchange.

Note: All gears fitted with caged needle roller bearings on Super Race set.

Miscellaneous

Exhaust manifolds made to customer's drawings or pattern. From £15.

Fullflow oil unions to take BSP unions. 75p per pair.

Sumps fully baffled for wet sump use. £2·75 exchange.

Sumps converted to dry sump type, fitted with gauze filter BSP union. £6 exchange.

Formula car

Chassis replicas for the DNC Mk 2. This is the only 750 formula car that is offered for sale that has been race proved, and has shown that it is capable of winning races. During 1971 a DNC won 6 races and broke 6 lap records.

Chassis. Complete with all pick up points ready to accept wishbones. £100.

Wishbones for front, front and rear radius rods and panhard rod. £30.

Fibreglass nose-cone. £8.

Rear axle, including shortening nearside, complete with all brackets. £17·50.

Go three wheeler, save your quids– Business use or wife-and-kids. Afford to buy it? Sure you can–

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