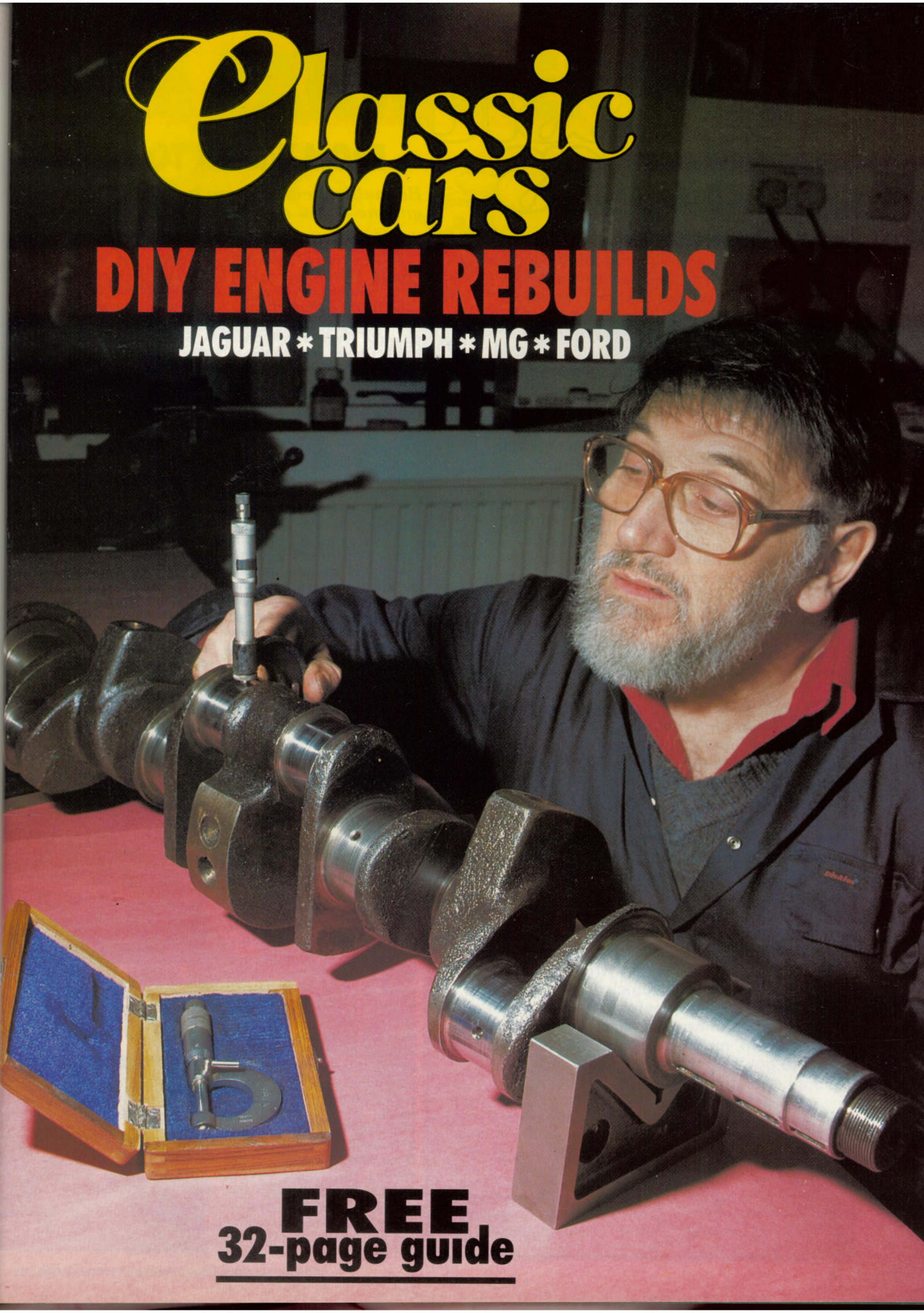
Classic cars

DIY ENGINE REBUILDS

JAGUAR * TRIUMPH * MG * FORD



FREE
32-page guide

Classic cars

REBUILDING an engine at home is one of the most satisfying things you can do. It seems like the heart of any restoration and that moment of actually getting the motor running for the first time always seems to be a memorable experience.

Strictly speaking I am talking about engine reassembly to as-new performance, for few of us have cylinder reboring and crankshaft regrinding facilities at home. Most people will need to go to an outside specialist for this work, but that takes none of the fun out of it.

Provided you can get yourself set up in reasonable comfort, with good light and clean conditions, this job should be within the scope of any enthusiast. It's a matter of being methodical, taking the time to measure things accurately and taking great care to reassemble everything correctly. Most of the engines from Classic cars are relatively simple, soundly engineered at heart and quite easy to rebuild several times over before really difficult work is required. I do recognise that some complicated engines are beyond my own expertise, however, but that's a judgement for each person to make individually.

One personal tip; measure everything you have had done outside to check that it is what the specialist claims it to be. I reassembled a small BMC engine once, using new pistons which a specialist had 'matched' for my block. The engine smoked horribly and had to come out of the car, which was very depressing. It turned out that the pistons were too small, a fact which amazed me as I had taken it for granted that the experts had got it right!

We hope that this special guide by our Practical Editor, Roy Berry, who founded the Colchester Institute's Vehicle Restoration course, will be very useful for you. Good luck if you are planning your first engine rebuild. If it's any help, my golden rules are; take your time to get it right, keep it clean and use plenty of oil.

Tony Dron
Editor
Classic Cars

WHAT MAKE

– FROM WRECK TO REBUILD

Be methodical; choose a simple OHV engine if you are a novice

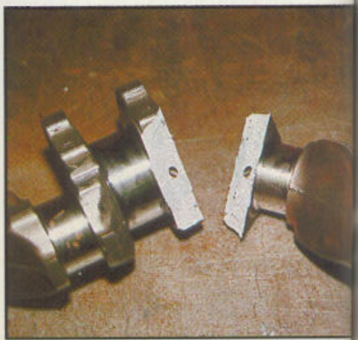
AN enthusiast friend of mine maintains that: "A restored car is painted and polished to make it look good or screwed together to make it go well." There is an implied conflict here, and I have to admit there generally seems to be a bias one way or the other. Be that as it may, it is the engine which gives life to the car, which determines its performance and can give such a rich satisfaction from its sound.

Getting an engine overhaul right depends on a number of factors: methodical dismantling, making right judgements, getting machining operations done by those who are not only equipped to deal with old engines but also sympathetic to them, followed by careful rebuilding and skilful final adjustments.

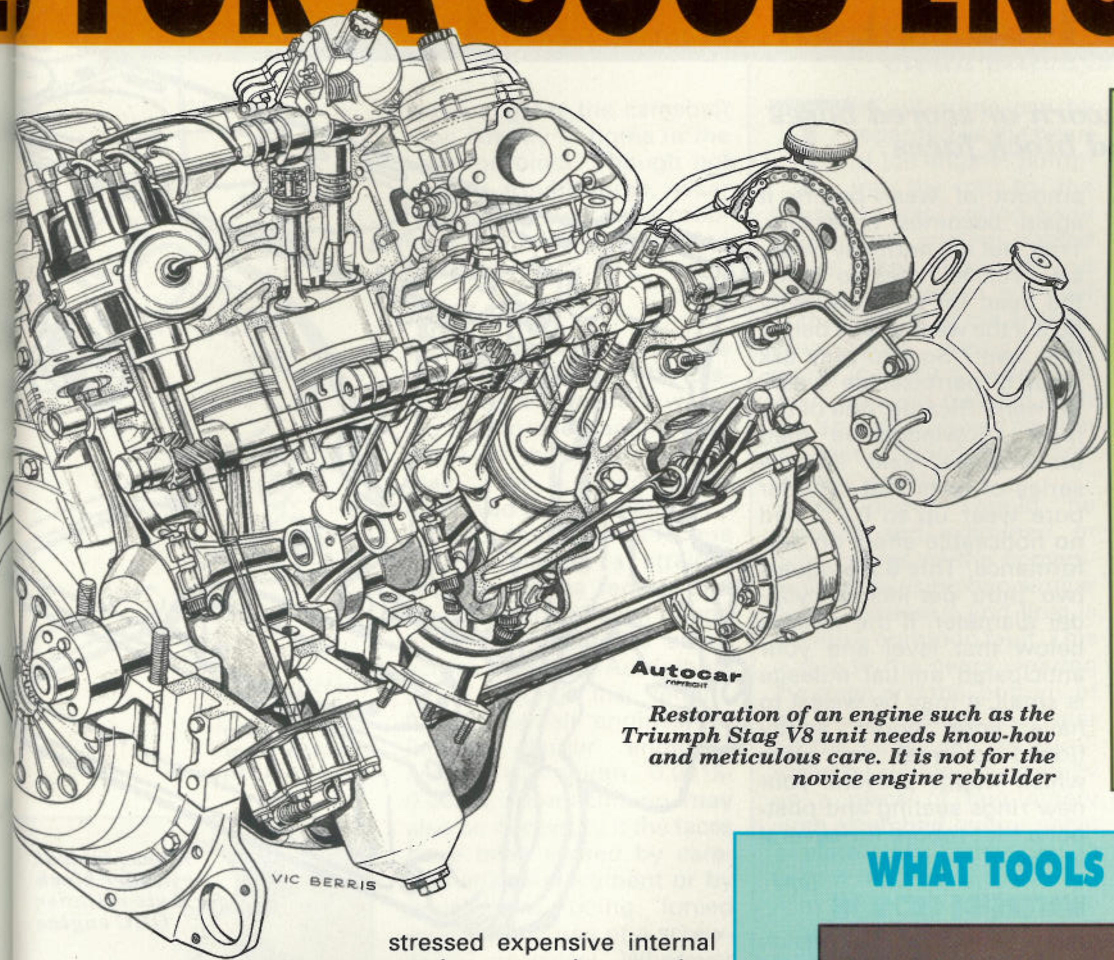
The well-equipped newcomer can cope with most of these in an 'easy' engine and fortunately the easiest engines to repair are the all-cast-iron pushrod OHV units typical of the period from just after the Second World War until the Seventies – our sort of cars. Engines such as the BMC/BL 'B' series used in the MGB, among many other applications, and the small Standard-Triumph unit, which started life in the austere mid-Fifties Eight and later powered the Herald and Spitfire ranges, are featured in the following pages. Little more difficult are the small Ford OHV units that began with the 997cc Anglia and appeared in many guises up to 1600cc and later got a great performance boost by the adoption of a cross-flow head. The more experienced home restorer might tackle the wet-liner Standard-Triumph engine that first saw the light of day in the 1948 Phase I Vanguard saloon and went on to power Triumph sports cars up to the TR4, as well as many Morgans. An engine like the Jaguar twin OHC XK unit is not one for your first overhaul but may not be beyond the scope of the home restorer with several successful engine builds behind him.

Supposing you have decided to have a go at an overhaul, there are two possibilities: That you are rebuilding an engine removed from your own car or that you are dealing with a salvaged engine. In the first instance you will know whether it has just 'got tired' or if a mechanical disaster has befallen it; in the other case the engine is an unknown quantity. Before purchasing an engine for a rebuild see if it turns freely with the spark plugs removed, if not and unless it is a very hard-to-find motor, look for another. Rust streaks on an engine mean a coolant leak, it may be innocous, a hose or something, but there is a good chance that it may be due to a frost-cracked block or head; investigate it thoroughly. If there is a lot of oil apparent exter-

Above, it is worth making a simple wooden rack to keep the valves and valve springs in the correct order after removal from the engine



S FOR A GOOD ENGINE?



Restoration of an engine such as the Triumph Stag V8 unit needs know-how and meticulous care. It is not for the novice engine rebuilder

GOOD HOUSEKEEPING AND SAFE WORKING

Institute some system of marking or recording where everything comes from, right down to bearing cap nuts so that they go back in their original places.

Get some good cotton overalls and where appropriate wear a cap, goggles and gloves. Make sure that any engine crane or jack you use has a very adequate safety margin. Remember too that any crane or lifting tackle is only as safe as the rope, chain or strop used to connect it to the engine! I like to use nylon strops especially made for the job and marked with their weight limit.

nally suspect something broken inside. If you are salvaging an engine from a crashed car make sure that there was no damage done to the engine mounting lugs or any castings. Remember too, that any engine that has stopped violently from high speed may have overstressed expensive internal moving parts. I remember from working on piston-engined aeroplanes that any crankshaft from a machine that had been 'belly-landed' (with wheels up) was subjected to a crack-detection test and also tested for twist before further use. What is good for aero engines also holds good for car units.

Below, proper lifting gear can be hired but is only as good as the rope, chain or strop which lifts the engine. This strop (below left) has its safe limit shown

Left, what seems to be a cheap replacement engine from a scrapyard can have a hidden fault such as this broken crankshaft

WHAT TOOLS AND WHEN

A number of general purpose tools will be needed; correct spanners are most important. Make sure you use those of the right system, Whitworth (Whit) sizes for British cars up to about 1955 except Ford and Vauxhall; for these and for British makes from about 1955 to the mid-Seventies use A/F sizes. In other instances you'll need metric sizes. There are a few exceptions, for example BA sizes were used for many years for electrical and instrument work on cars. You should not attempt to slacken nuts securing major items such as cylinder heads or bearing caps using an open ended spanner; this will stretch dangerously, with the possibility of personal injury should it slip, and will almost certainly damage the nuts. The right tools to use are ring spanners or sockets, in the latter case avoid using the ratchet handle or the universal joint for initial slackening. You'll need compressors for valve springs and piston rings plus a valve-grinding stick. Finally, if you are going to make you own decisions about which components to machine and the finished sizes you want – it might be wise to leave this to an expert – you will need some measuring instruments and the necessary knowledge to use them.

CYLINDER BLOCKS

Look for corrosion, worn or scored bores and damaged block faces

SINCE the mid-Thirties it has been conventional practice to combine the cylinder block and crankcase into a single unit. It is this type of construction we will be considering here.

The block is the largest single component of an engine; it is the starting point from which the engine build begins. It's the sensible place to start and it is essential to get it right.

It is important to check the block very thoroughly before any work is done on it. Possible causes of the rejection of a block would be excessive cylinder wear or damage, internal rust perforation, faults with the housings for the main bearings or camshaft bearings, badly damaged joint faces and excessive crankshaft end float. Let's look at these one by one.

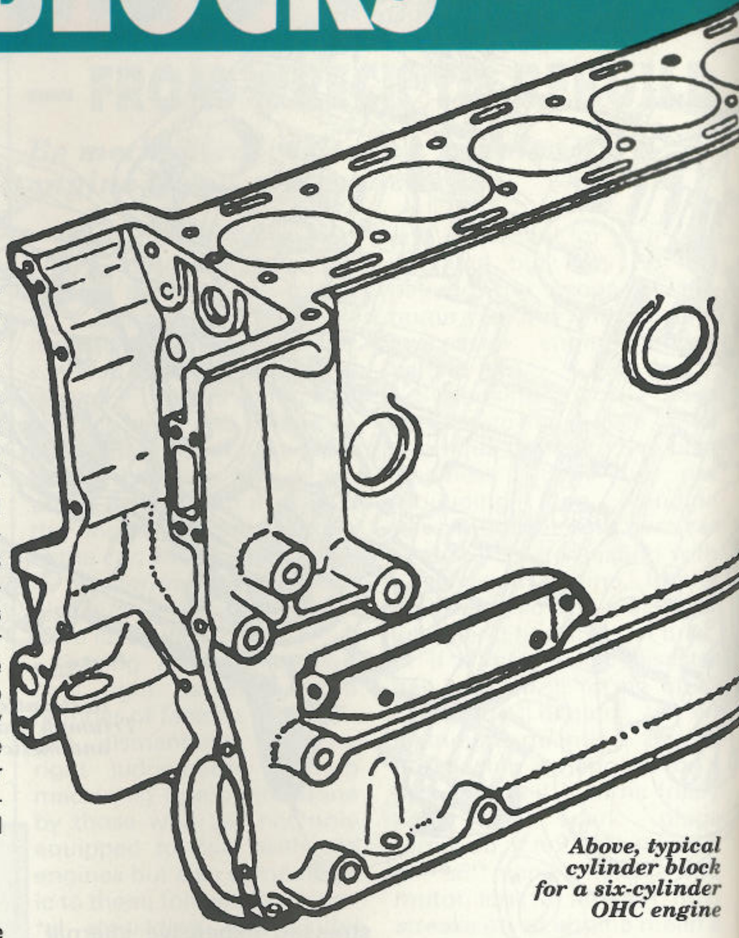
CYLINDER WEAR

Normally the maximum oversize that a block can be bored to is 0.060in (60 'thou'). If your engine has already been bored to this limit there still may be a solution to the problem by boring the cylinders once again and pressing in sleeves which are then rebored to the original size so that you start from scratch once more. This is a good method, especially since the sleeves will probably be longer-lived than the original bores because they are made from hard-wearing material. As well as wear, this method can be used to rectify minor cylinder damage such as that which occurs when a gudgeon pin comes adrift and cuts 'tram lines' in the bore. Re-sleeving is not, however a cure for all ills, it can only be done if there is enough metal left in the block to support the sleeve and many bores are pretty thin after being bored to '60 over', ignoring the rust erosion on the water side.

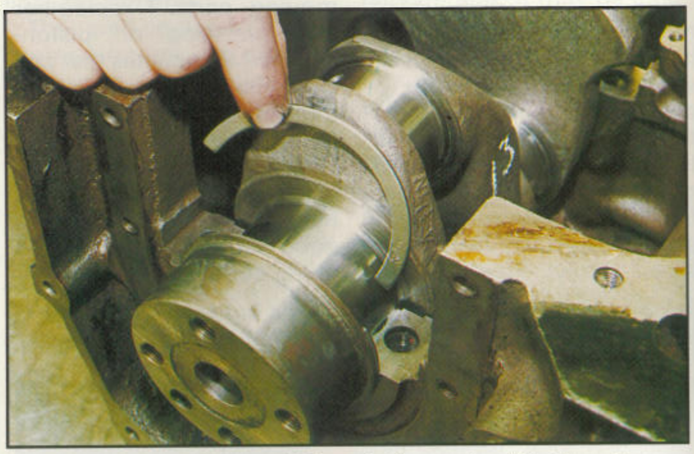
Some restorers like to rebore the engine as a matter of course, arguing that this provides the maximum amount of wear before it again becomes necessary. True, but if it normally takes, say, 70,000 miles to reach the need for a rebore, why do it if the wear is well below that level? So you may ask what is permissable wear? Sir Harry Ricardo, one of the most knowledgeable men on engines, said after a series of tests that cylinder bore wear up to 0.2% had no noticeable effect on performance. This 0.2% equals two 'thou' per inch of cylinder diameter. If the wear is below that level and your anticipated annual mileage is small, it may be wisest to have your bores lightly honed to break any glaze which might prevent your new rings seating and postpone that rebore for several years.

WATERSIDE EROSION

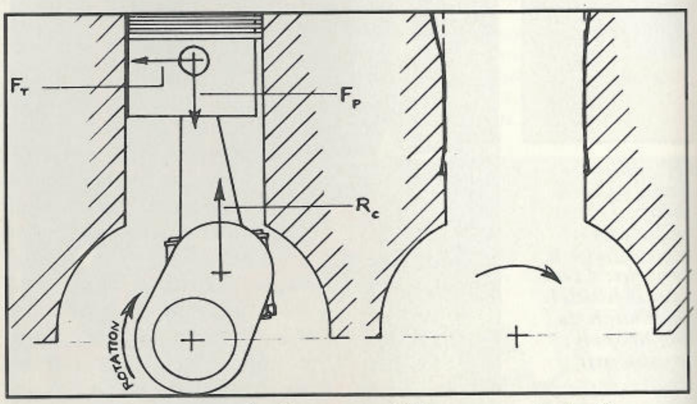
Rust acting on the inside of the cooling waterjacket can thin its walls disastrously. It is not unknown for it to perforate the cylinder walls; not so many years ago I came across an Austin Seven engine where this had happened near the bottom of the bores. The outer walls of the block can also be seriously thinned by internal corrosion: I recently saw a wet-liner block from an expensive sports car engine where an increase in compression ratio had increased the combustion force sufficiently to crack the badly-thinned walls of the waterjacket below the head studs! Be warned; take a good look for excessive corrosion here *after* you've poked out loose rust using an old screwdriver. This task is easier in open deck wet-liner engines but in these you need to take a good look at the outside of the liners, which are likely to have a vertical line of erosion at right angles to the plane of the crankshaft, and their seatings in the block. Finally remember that to avoid overheating, the block waterways must be free of clogging by rust or scale.



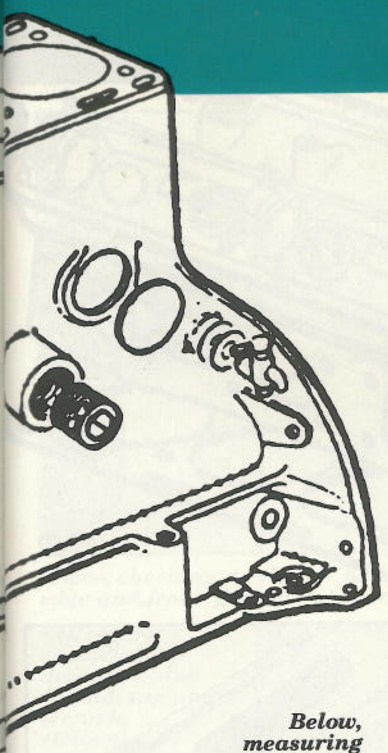
Above, typical cylinder block for a six-cylinder OHC engine



Above, the crankshaft end-float is determined by thrust washers in the crankcase



A cause of bore wear. At the start of the power stroke force on piston (Fp) is out of line with reaction at crankpin (Rc) so con-rod rotates anti-clockwise about crankpin creating heavy thrust (Ft) on left-hand cylinder wall



Below, measuring cylinder bore wear using a comparator gauge

Some engines used a water distribution tube in the block. If one was fitted originally in your engine you should treat it as essential rather than an optional extra.

MAIN BEARING HOUSINGS

These were bored in line, with their caps fitted, when the engine was built. Where thin-wall shell bearings are used, as is generally the case, any serious damage in this area is likely to be irrecoverable. In any case don't buy a block where the bearing caps are missing, it is not a simple case of finding replacement caps. In some engines the camshaft runs directly in bores in the cast-iron block. Though not usually troublesome, wear here could also pose problems for the home engine rebuilder.

JOINT FACES

Cylinder block joint faces are much less likely to be distorted as the result of warping due to overheating than those of the head. A face may be dangerously narrowed by corrosion.

Check that the top face is flat by placing a straight edge along its length and trying to slide a feeler gauge under it; repeat the check across its width. Acceptable limits: along the length, 0.004in (small engines) to 0.006in (larger engines); across the width 0.0015-0.002in. Re-machining may also be necessary if the faces have been scored by careless stud replacement or by joint faces being forced apart by the use of a screwdriver or chisel. Wherever possible machining the block face which mates to the head should be avoided, as an unwanted increase in compression ratio would result.

CRANKSHAFT END FLOAT

This is not usually a problem as the thrust washers come in various sizes, however some engines, especially Triumphs of the Sixties, can be troublesome. Check the end float (see photos) before dismantling. If it is excessive, make sure that thicker thrust washers are available to correct it. It is not unknown for Triumph engines to shed their thrust washers with disastrous results.

STUDS

It is essential that the studs are in good condition, with their surfaces uncorroded, that they are not stretched by overtightening, and that their threads are not damaged. See that the female threads in the block which accept the studs are sound. If not, they can generally be reclaimed by a method known as Helicoiling.

LUBRICATION SYSTEM

A correctly-functioning oil pump and clean oilways are essential

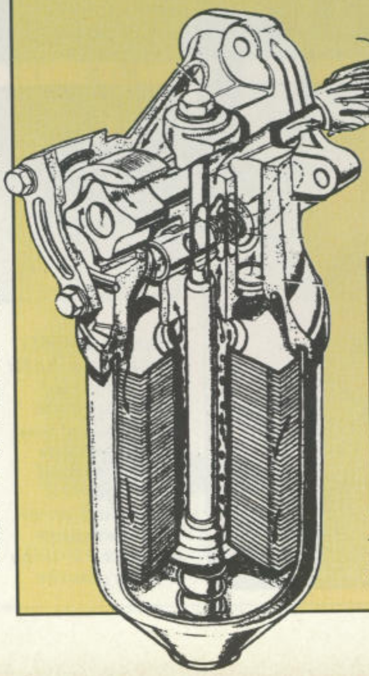
THE oil pump can be regarded as the heart of the engine; pumping the oil to the stressed areas, easing away friction and cooling heated zones. The oil pump and lubrication system are vital to the 'health' of the engine. What goes wrong? The pump is likely to wear, oilways become clogged with dirt and relief valves can fail to seat properly or their springs weaken.

The pump should be stripped and examined. In gear pumps of the conventional type using two similar gears, excessive end-float is the most common fault. This is due to the gears wearing the cover and the 'bottom' of the pump casing. The wear on the cover can be eliminated by rubbing it carefully on a piece of fine emery cloth stretched over a sheet of plate glass, taking care to keep it flat and not allowing it to rock. The wear at the other end is less easy to deal with at home; about the best you can do is to rub down the body in the same way as the cover but it requires rather more skill to keep it flat. A machine shop may be able to mill out the bottom of the casing and then shorten the body to eliminate excessive float.

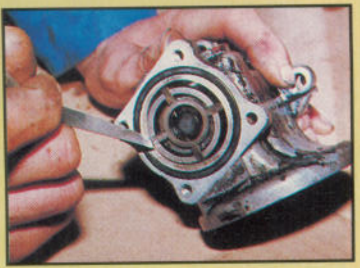
Rather less can be done about the eccentric-rotor (Hobourn-Eaton) and vane-type pumps. Check the clearances between the rotors of the eccentric-rotor pump against the data in your workshop manual. In all three types significant scoring of the internal parts will make the pump inefficient and require its replacement. Some engines, notably those BMC/BL units which share their oil with the gearbox, will need a new oil pump at every overhaul.

If the plunger or ball in the relief valve is worn, ideally it should be replaced. Where the valve is a ball it should be seated by one good hammer blow delivered through a soft punch. A new plunger will need to be *lightly* lapped on to its seat using fine valve-grinding paste; be fastidious about removing every trace of paste afterwards. If the relief-valve spring has weakened, it can be boosted by assembing it with one or two washers at its outer end.

Oilways should be 'rodded' out; a piece of $\frac{1}{8}$in welding rod is ideal for this. Try to dislodge as much accumulated gunge as possible, then swill through the drillings with paraffin delivered by a force-feed oil can and, if possible dry out with a blast of compressed air. Some engines, like $1\frac{1}{2}$-litre RM Rileys and Jaguars, have plugs which give access to sludge traps in the crankshaft. At major overhauls it is very important to remove these and dig out the sludge from the space behind.

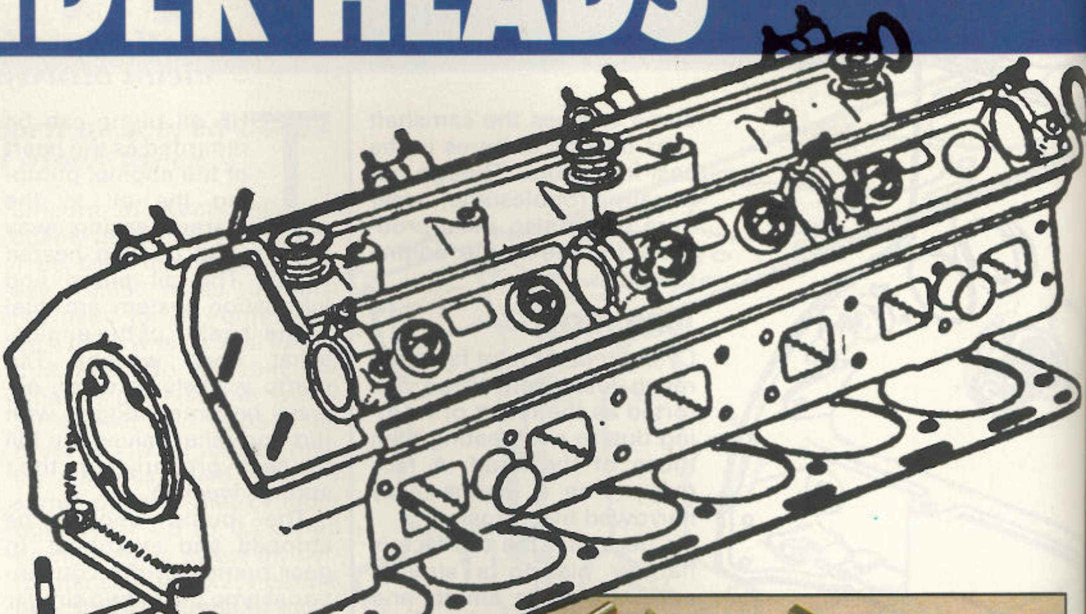


Left, on the Ford Anglia an eccentric lobe-type oil pump is incorporated in the top of the oil filter body. The pump portion has its own relief valve with a separate one for the filter side of the unit



Above, oil pump clearances must be small to generate good oil pressure

CYLINDER HEADS



Look for flatness of the cylinder head face and corrosion of the waterways

THE joint face should be checked for flatness (see Cylinder Block section) and for excessive corrosion around the waterways, both of these faults being more common on aluminium alloy heads.

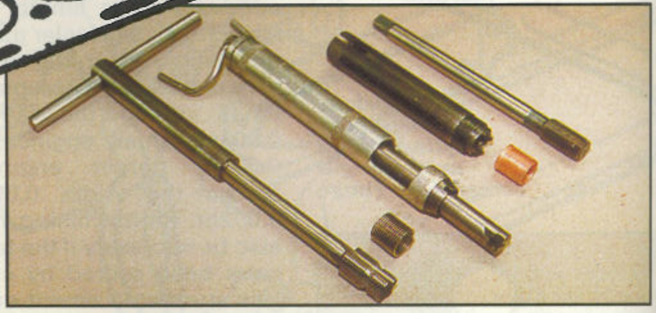
Any studs fitted to the head should be checked as for those on the block and renewed if necessary.

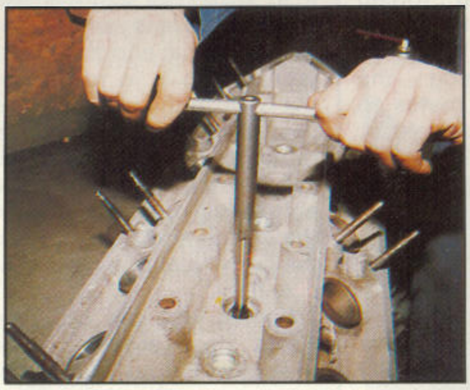
Remove any casting 'rags' left in unmachined combustion chambers using a rotary file in an electric or compressed-air drill and minimising the amount of metal taken away.

Some heads incorporate a water distribution tube or thimbles to direct cool water to known hot spots such as the valve seatings and spark plug bosses. It is essential that such tubes or thimbles are in good condition and all of the outlets are clear.

See also the section on valves and operating gear on pages 8 and 9.

Above, six-cylinder XK engine. Always look for corrosion in the waterways through lack of the correct anti-freeze





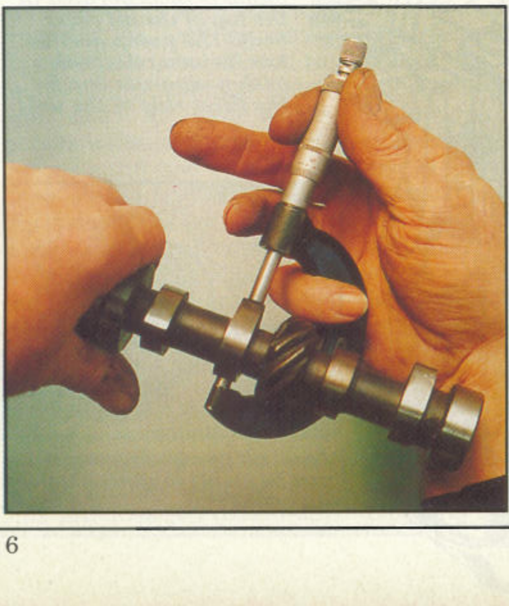
Right, tapping a damaged plug thread on a Jaguar head to suit a Helicoil insert

Far right, the Helicoil wire insert fitted into its special insertion tool

Right, the Helicoil ready to be inserted

Far right, the Helicoil being screwed home. The last part of this operation breaks off the 'tang' by which it is driven

CAMSHAFTS

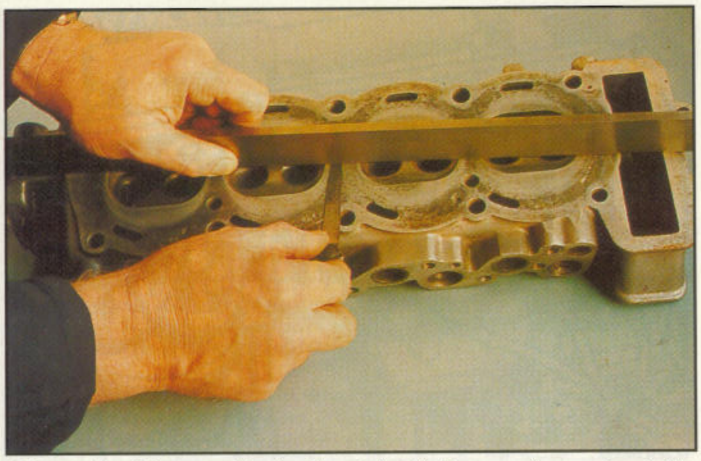


Above, a badly worn camshaft; the lobes are worn and the hardening has broken down

Left, a visual check for camshaft wear is not enough; measure it with a micrometer

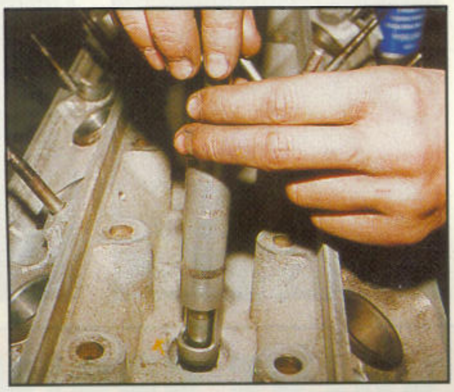
CAMSHAFTS convert rotary motion into reciprocating motion; They deteriorate in several ways: the cam lobes can wear, reducing the valve lift and the period for which the valve is open; the edges of the cam can become rounded; the hardened surface may break down so that very rapid wear ensues. Often a camshaft carries an integral skew gear to drive a distributor or oil pump, this might be excessively worn. Inspect your shaft(s) for all of these faults. It is worth measuring across the peak of the cams and comparing one with another and preferably with a new shaft. Once I recorded a difference of 70 'thou' between lobes on a MGA camshaft. The bearing surfaces may have been damaged by oil starvation.

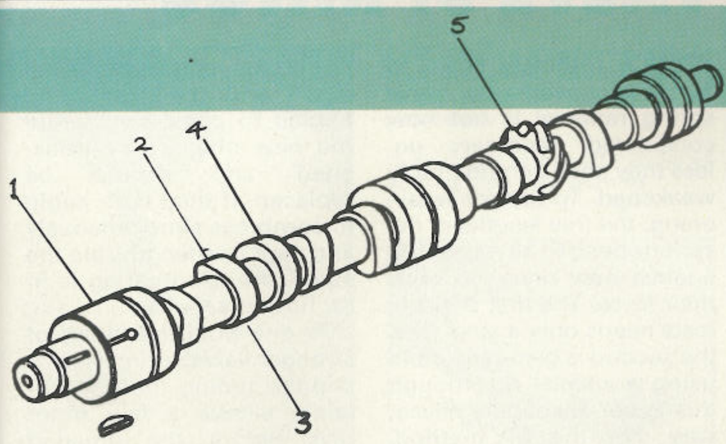
Along with the camshaft, the mechanic should include the tappets or followers; in many engines these will be worn by the time an overhaul is due. If your engine is to run quietly there must be *no marking* on the face that bears on the cam and the sides must be parallel and unworn.



Above, checking a cylinder head for flatness using a straight edge and feeler gauge. Note corrosion pitting

Left, kit for repairing a damaged plug thread: tap and wrench, Helicoil wire insert, the Helicoil insertion tool, seating tool and Wurth insert, Wurth tool. Right, damaged hole is marked





Camshaft of the four-cylinder MGB engine, viewed from the front of the shaft: 1 Front journal; 2 Peak of cam lobe; 3 Base circle of cam; 4 Fuel pump eccentric; 5 Skew gear to drive the distributor and oil pump. Like most camshafts it is chain-driven from sprockets (not shown) mounted on the nose

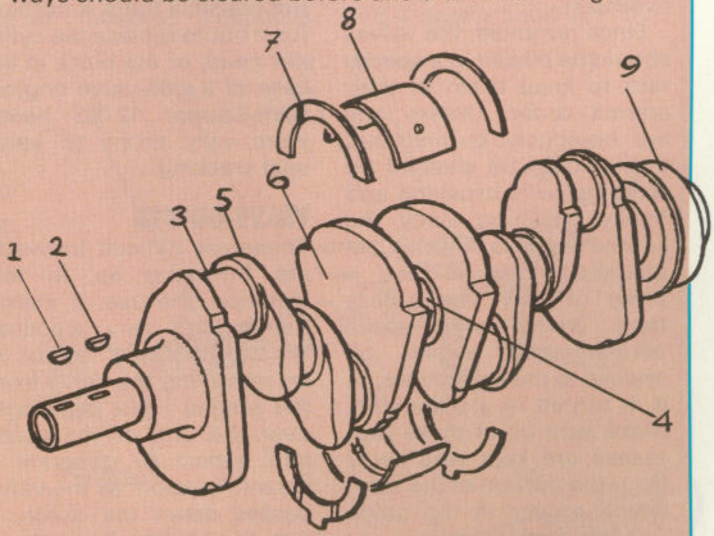
CRANKSHAFTS

Condition should be assessed by inspection and measurement

CRANKPINS and main journals should be measured in the appropriate places to determine ovality and taper; neither should show a discrepancy of more than about 0.001in from the original or reground diameter. There should be no heat discolouration of pins and journals and no scoring, ridging or grooving.

Using a surface table, vee blocks and a 'clock' gauge with a magnetic base, the shaft should be tested for bowing and twisting. Visual tests should be carried out on threads, keyways, the flywheel register, oil slingers, oil return scrolls or oilseal tracks.

If the type of engine has a history of breaking crankshafts (eg Jowett Javelin, Aston Martin DB2 and DB2/4) or if the engine is from a heavily-crashed car, it should be subjected to a crack detection process. All oilways should be cleared before and after machining.



MGB crankshaft: 1 Woodruff key, crankshaft pulley; 2 Woodruff key, crankshaft sprocket; 3 Crankpin; 4 Main journal; 5 crankshaft web; 6 Balancing mass; 7 Thrust washer halves; 8 Shell bearings, centre main; 9 Rear oilseal track and flywheel flange register

Testing crankshaft for 'bow'. Gauge mounted at centre main journal should show steady reading when shaft is turned

Testing crankshaft for twist. Both end crankpins should be the same height from surface table, as shown by dial guage

VALVES AND OPERAT

Smooth running and performance depend on condition of valves, seats and guides

VALVES AND SEATS

EXHAUST valves in particular are subjected to a great deal of thermal stress combined with impact loading. The valve operates at about 700°C – cherry red – and is cracked back on to its seat up to 3,000 times a minute by the force of its springs. Little wonder that some engines need new exhaust valves at every top overhaul!

Once removed, the valves should be placed in a special rack to keep them in their correct order. Unless any are obviously burned out, they should be cleaned by scraping, wire brushing and finally polishing away the carbon deposits. For this last operation I like to use a piece of very fine emery tape, wetted with some paraffin and engine oil applied to the valve head, as it is turned in a pillar drill. Make sure all of these processes are kept well away from the portion of the stem which moves in the guide and the seating area.

After cleaning, the valves need to be inspected carefully. Roll the valve stem on a surface plate or a piece of plate glass and look for indications of bending. A bent valve must be scrapped.

The stems should be measured on their worn and unworn parallel portions using an external micrometer or a vernier gauge. If there is any detectable difference the valve should be replaced.

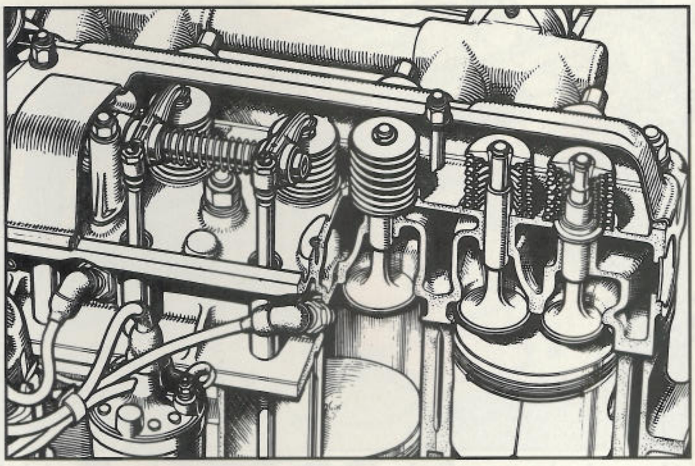
Generally, it will be necessary to lightly reface the valves on a suitable machine before lapping them in. After refacing see that there is still a good land above the valve seat – that it hasn't become knife-edged. Such a valve would be subjected to a great deal of thermal stress and would be short lived.

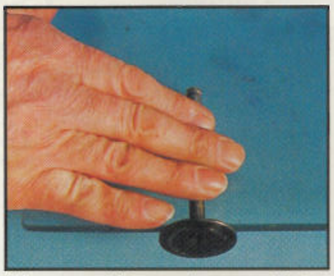
If new valves are available, it will generally be wise to fit new exhausts.

Valve seats should be inspected for wear, in most instances some recutting or stoning of the seats may be necessary before lapping in. If the valves are pocketed it will be necessary to renew the appropriate seatings. Cracking of valve seatings, particularly those of the exhausts, is far from unknown. Clean the seatings and inspect them carefully under a strong light. If there is a crack, a new seating should be fitted where possible (a specialist job). If not possible there is nothing for it but to replace the cylinder head, or the block in the case of a side-valve engine. Mini-Cooper 1275S heads were very prone to valve seat cracking.

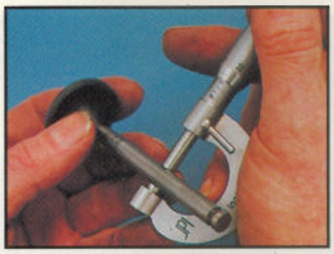
VALVE GUIDES

These are difficult to evaluate for wear as, in this instance, the use of instruments isn't very practical. What I do is this: first of all on removing the valve from the engine I put my finger over the end of the guide and expect to generate a decent 'suction' as the valve passes down the guide, if not the guide is suspect. After that with the valve and guide cleaned and dry, I place the valve in its guide with *its head off its seat* and waggle the valve to and fro in the plane of operation of the rocker, tappet or camshaft, I then waggle it again at right angles to the plane of operation. If the movement in the plane of operation is detectably greater, the guides should be renewed. In a few engines valve guides are in contact with coolant, these should always be replaced routinely at each top overhaul. Some Ford and Vauxhall engines dispense with separate guides, the valves running in machined bores in the head. If wear is apparent, these bores have to be reamed oversize and valves with oversize stems fitted, a job for the specialist. After fitting valve guides (or reaming out bores on Ford/Vauxhall engines) the valve seats must be recut, piloting off the new guides or newly-reamed bores.





Above, rolling valve on plate glass to test for bending



Measuring the diameter of a valve stem with a micrometer

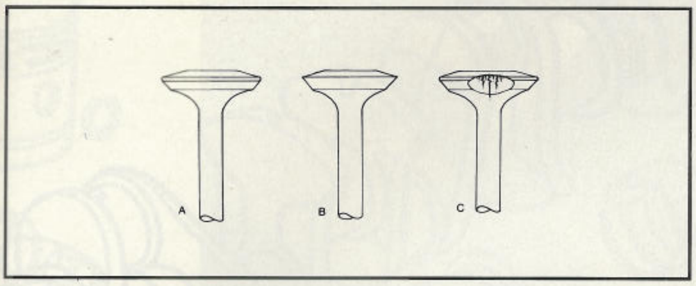
Below, cleaning deposits off the head of a valve by rotating it in a pillar drill and holding emery paper against it

VALVE SPRINGS

ONCE routinely changed at top overhauls, valve spring renewal is not now considered necessary unless they have demonstrably weakened. To test for weakening, the free lengths of the springs need to be measured against new ones, so does their force. The first of these tests needs only a steel rule, the second is generally done using a special rig, though this is not absolutely necessary. For the DIY method, the spring to be tested is placed vertically on a piece of steel plate on the bench and on top of it is placed another, smaller piece of plate, then a new spring and finally a third piece of plate. If the top plate is pushed down and the old spring begins to compress before the new one, it has weakened and should be replaced. If they both begin to compress simultaneously and their free lengths are the same, the used spring is fit for further service.

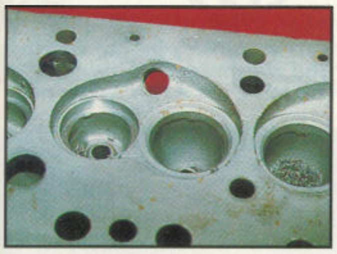
At one time the fitting of stronger valve springs was a popular tuning mod. It certainly allows a few more revs before the dreaded valve bounce sets in, but the greater spring force leads to earlier deterioration of the valve and seat. For that reason, I wouldn't advise it for engines intended for normal road use.

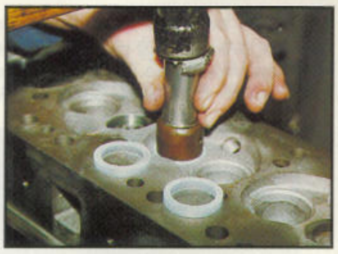
ING GEAR



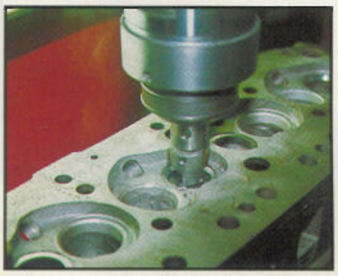
Above, valves should be examined carefully: A *In good condition;* B *With a good face but worn thin by excessive refacing;* C *In a burnt condition*

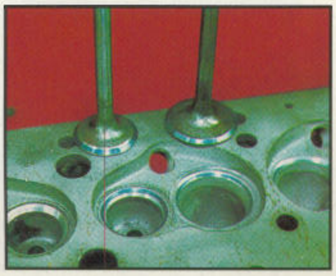
Left, the Triumph TR2 overhead valve layout is typical of many four-cylinder engines. Valve operation is by way of pushrods and a central rocker shaft with individual valves worked via rockers on the shaft





Fitting valve seat inserts. Above left, old seat machined out square. Above right, new seats, cooled in liquified oxygen, are fitted to the head, which is at room temperature. Below left, new seating being machined. Below right, check with engineers' blue shows seats do not need lapping





Left, testing a valve spring in a proper professional rig which gives a read-out of poundage

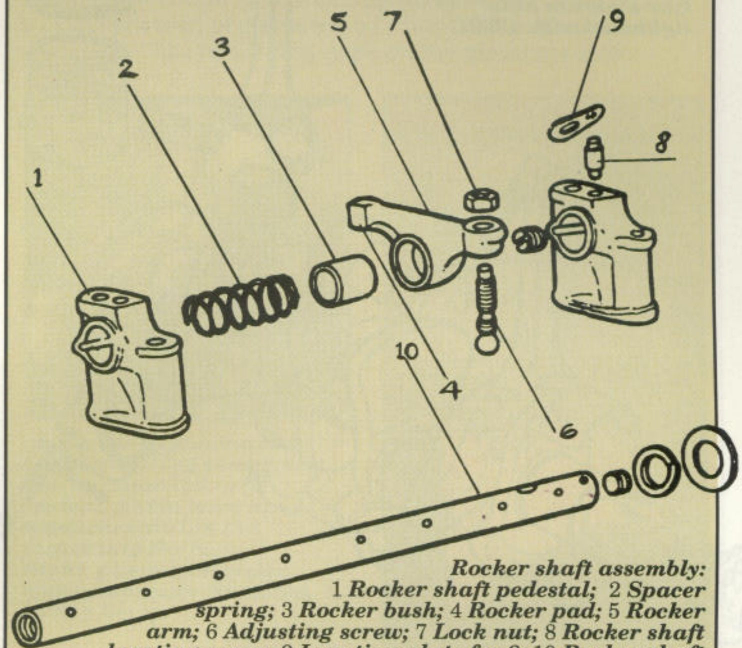
Below, one of the DIY ways of testing valve springs by comparing two springs

ROCKER GEAR

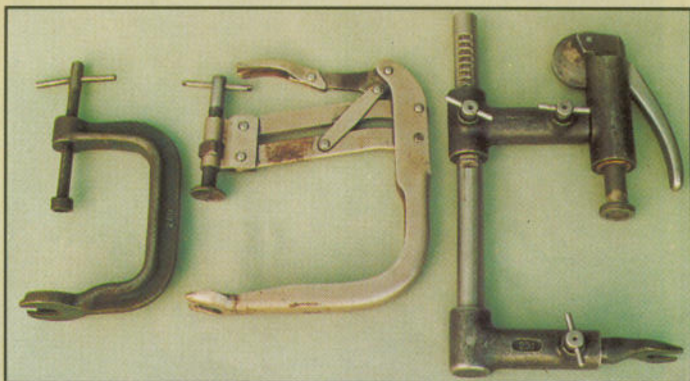
It is important to dismantle the rocker shaft and inspect it for wear

ROCKERS and their shafts are often removed as an assembly, put to one side and then replaced without being dismantled. Unfortunately, as a result, a lot of amateur overhauls are not so good as they would be otherwise.

The assembly should be dismantled carefully, taking care to keep all the rockers, springs, spacers and pedestals in their correct order. The shaft should be examined for wear, which can be considerable, and the rocker bushes, adjusting screws and pads scrutinised. Worn rocker shafts are not normally reclaimed. If the rocker pads are worn it is unlikely that you'll be able to reprofile them sufficiently well to operate properly without exerting an undue sideways force on the valves, which would cause premature valve and guide wear. Fitting new rockers, if available, is the best policy. Reassembly is a careful reversal of dismantling, ensuring that all oilways feeding the rockers are clear and properly lined up.



Rocker shaft assembly: 1 *Rocker shaft pedestal;* 2 *Spacer spring;* 3 *Rocker bush;* 4 *Rocker pad;* 5 *Rocker arm;* 6 *Adjusting screw;* 7 *Lock nut;* 8 *Rocker shaft locating screw;* 9 *Locating plate for 8;* 10 *Rocker shaft*



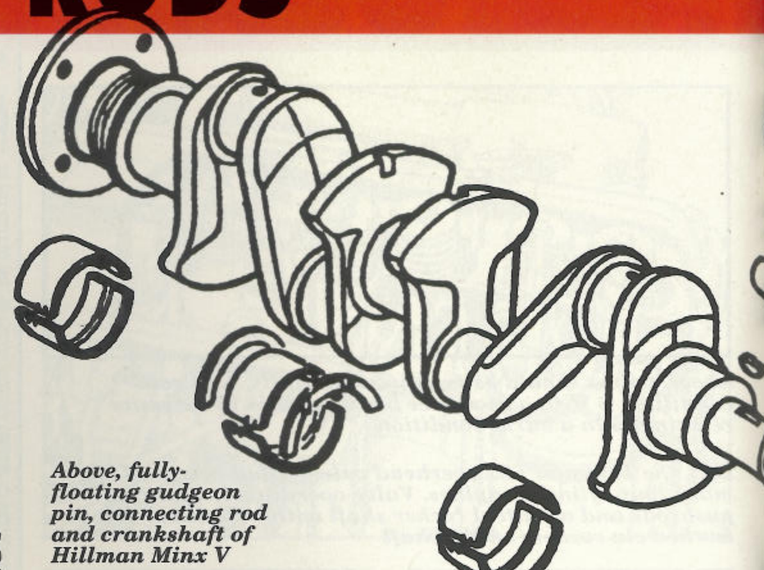
Above, valve spring compressor types (left to right): screw, lever, cam

Left, basic equipment for lapping valves: an inexpensive grinding stick with rubber suckers to grip the valve and a tin of grinding paste

CONNECTING RODS

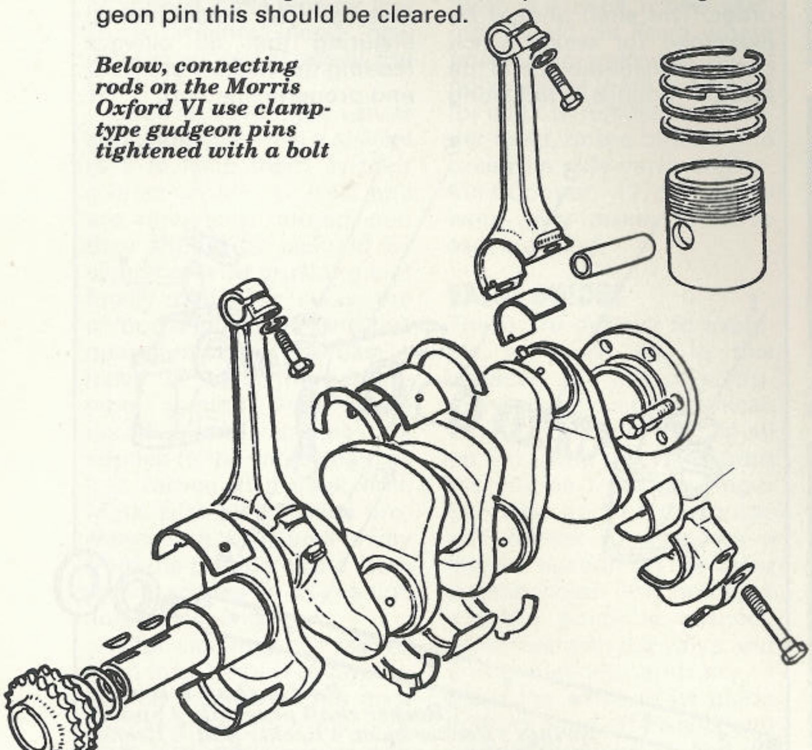
Don't forget to check condition of gudgeon pins and big-end bolts as well

THESE should be tested for twisting, bowing and bending. The eyes should be tested for circularity. If a clamp-type gudgeon is used the bolt should be examined for damaged threads and any sign of 'necking'. Where there is a fully-floating gudgeon pin, the condition of the small-end bush and its fit on the pin must examined. As with crankshafts, the crack detection and balancing of these highly stressed parts is very desirable. Big-end bolts and nuts should be examined and rejected if the threads are damaged or there is any sign of the bolt being stretched – compare the length with a new one. If there is a drilling to feed oil to the cylinder wall or gudgeon pin this should be cleared.



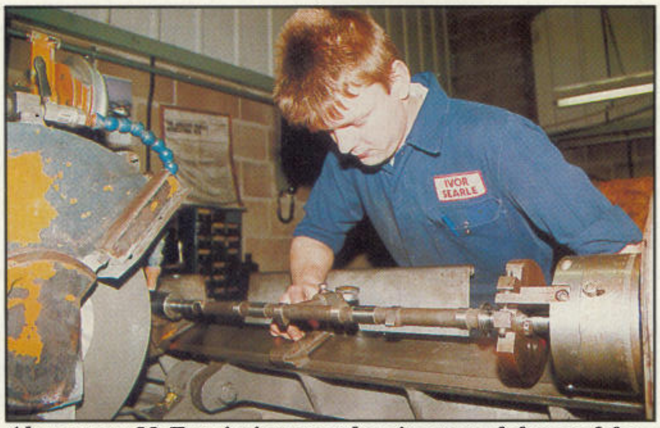
Above, fully-floating gudgeon pin, connecting rod and crankshaft of Hillman Minx V

Below, connecting rods on the Morris Oxford VI use clamp-type gudgeon pins tightened with a bolt



Below, installing an interference fit gudgeon pin: the small-end eye has been locally heated and the gudgeon pin is slipped in by hand. On cooling, the rod shrinks on to the pin

Right, connecting rods (left to right): interference fit gudgeon, perpendicularly-split big-end eye; clamped gudgeon, obliquely-split eye; bushed with fully-floating gudgeon



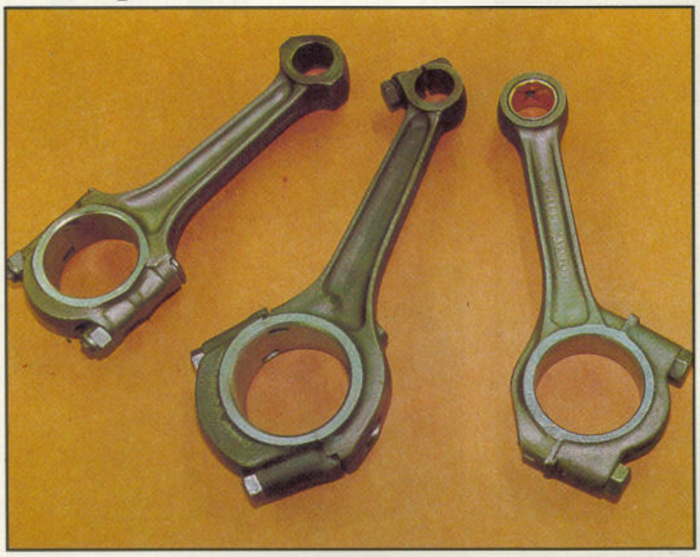
Above, new MoT emissions test has increased demand for reprofiled camshafts, here being ground for a Jaguar

ACKNOWLEDGEMENTS

We would like to thank the following for giving advice, assistance and photographic facilities for this supplement: Mike Searle, Steve Bullman and Chris Alitt of Ivor Searle Engine Reconditioners; Allan Sharpe, Michael Baker, John Bell and John Black of Colchester Institute; Alan Walker and Lee Tillyer of Moss Europe; Martin Cronin of Rally Services; the Federation of Engine Remanufacturers

WATER PUMPS

Above, it is vital to number big-end bearing cap and connecting rod before dismantling, to ensure that the cap goes back on the same rod and is the right way round on reassembly



PUMPS should not be overlooked. The common reasons for rejection are faulty bearings or leakage, although seriously corroded impellers and pump bodies also occur. For most of the more popular post-war Classic cars replacement pumps or overhaul kits can be had; if not I'm afraid its down to your ingenuity to find a solution, perhaps with some aid from a machine shop.

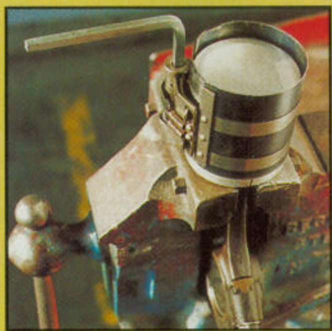
Left, this pump is suffering from a badly corroded impeller, possibly because plain water has been used in the cooling system instead of the correct antifreeze containing a corrosion inhibitor

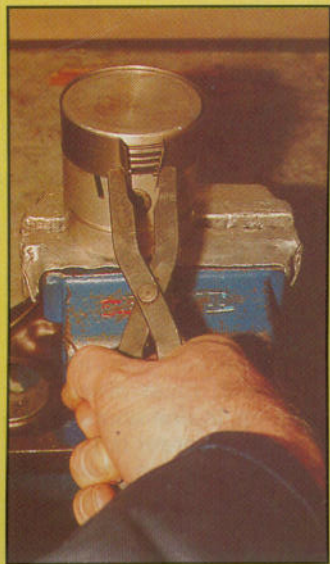
PISTONS

Condition of pistons and rings affects performance and oil consumption

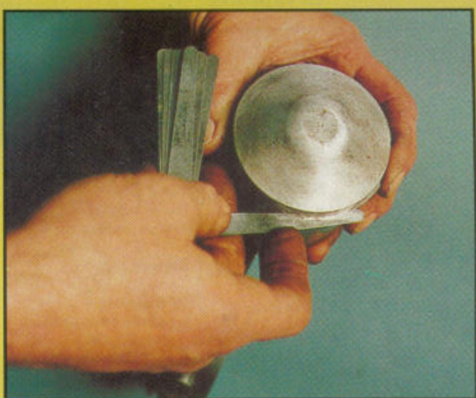
ON dismantling, number each piston and mark it for front (do not use number or letter stamps near the edge of the piston crown – I scratch the number and the letter F inside the skirt), since, unless the engine is to rebored, it may be possible to reuse its pistons. There should be no signs of serious scuffing due to partial seizure and no flame erosion of the crown. This condition, referred to in the trade as 'the mice getting at it', is caused by a combination of overheating and detonation. It does look as though the piston crown has been nibbled by small rodents and, if neglected, may lead to a holed piston.

Check that there are no cracks around the ring belt or skirt and that the ring groove width, especially that of the top one, is not excessive. Do check that the gudgeon pin fit is OK. Never replace pistons except as a complete set. Don't rely on piston rings being pre-gapped, check the gaps – rough guidance: compression rings 0.002-0.003in per inch of diameter; oil rings 0.004in per inch of diameter. I like to set ring gaps on the generous side.





Above, the popular sleeve-type piston ring compressor can be expanded to fit various piston sizes and is used when fitting the piston into the bore
Right, pliers-type piston ring compressor favoured by Roy Berry



Left, testing piston ring side clearance using a feeler gauge

ROUTINE REPLACEMENTS

WHEN overhauling an engine it is good practice always to replace all gaskets, oil seals, core plugs, piston rings, shell bearings, oil filters, timing chains and locking split pins, plates and wire.

Thermostats, oil coolers, radiators, manifolds, carburettors, fuel pumps, injection equipment, distributors, plugs, coils and leads are engine ancillaries and outside the scope of this work.

THE FORD 105E ENGINES

THIS unit caused something of a sensation at its introduction because of its extremely 'over square' dimensions. It was referred to in the motoring press as the '80 bore' Ford engine. In fact its bore was just under 81mm and with a stroke of 48.4mm it gave excellent breathing and a low piston speed at the high sustained cruising speeds made possible on the new motorways of the early Sixties, however these advantages were gained at some cost in terms of low speed 'pull', fuel economy and ease of starting.

Ford engines are generally easy to work on but a few points need to be borne in mind: when replacing valves the stem should be measured since previous replacements with oversize stems may have been fitted to overcome wear in the integral guide bores in the head.

Should it be necessary, the oil pump can be replaced without removal of the sump.

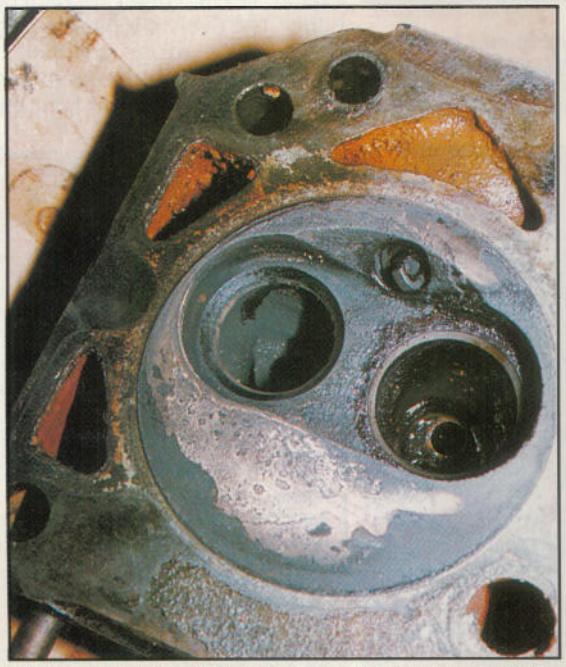
Remember that in contrast with most other four-cylinder in-line engines, the Ford firing order is 1,2,4,3.

Where, as in this case, sump sealing is by more than one gasket, these are best cemented into place before fitting.

Above, worn rocker shaft: locating groove and oil feed (centre), choked oil drilling to rocker on right

Above, bearing surface inside this rocker is badly worn and scored

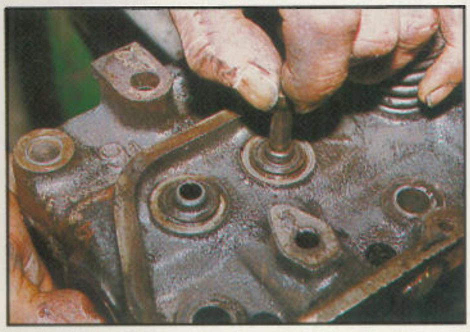
Above, the pads of these rockers are bady indented so that it is impossible to obtain the correct clearance



Above, deeply pitted exhaust valve seat needs to be refaced or an insert fitted. Inlet may respond to lapping

Right, exhaust valve might be saved but it is better to replace, if available

Below, testing a valve guide; if worn it must be reamed oversize



FORD ANGLIA 105E — *MOTOR TRADER* SERVICE DATA

Mounting

At front, rubber mountings are bolted up to brackets bolted to either side of crankcase and to abutment brackets on body frame. At rear, engine/gearbox unit is flange-bolted to frame extensions; flange is on underside of gearbox extension and rubber mounting is sandwiched between.

Tighten all bolts fully.

Removal

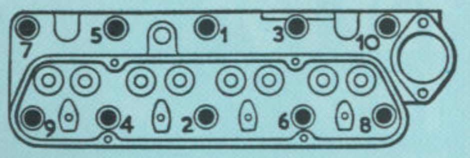
Engine may be removed with or without gearbox. Manufacturers recommend removal of engine as separate unit.

To remove engine alone, drain water from cooling system and oil from engine. Take off engine splash shield. Remove bonnet by disconnecting its support, unscrew pivot bolt (lock washers and flat washers on each side) and lift off bonnet unit complete. Disconnect and remove battery, remove air cleaner. Disconnect and remove upper and lower radiator hoses also heater hoses. Undo mounting bolts and take out radiator matrix. Disconnect all pipes, wires and controls to engine unit including exhaust pipe at manifold flange joint. Detach heater motor unit, place to one side to increase access to engine.

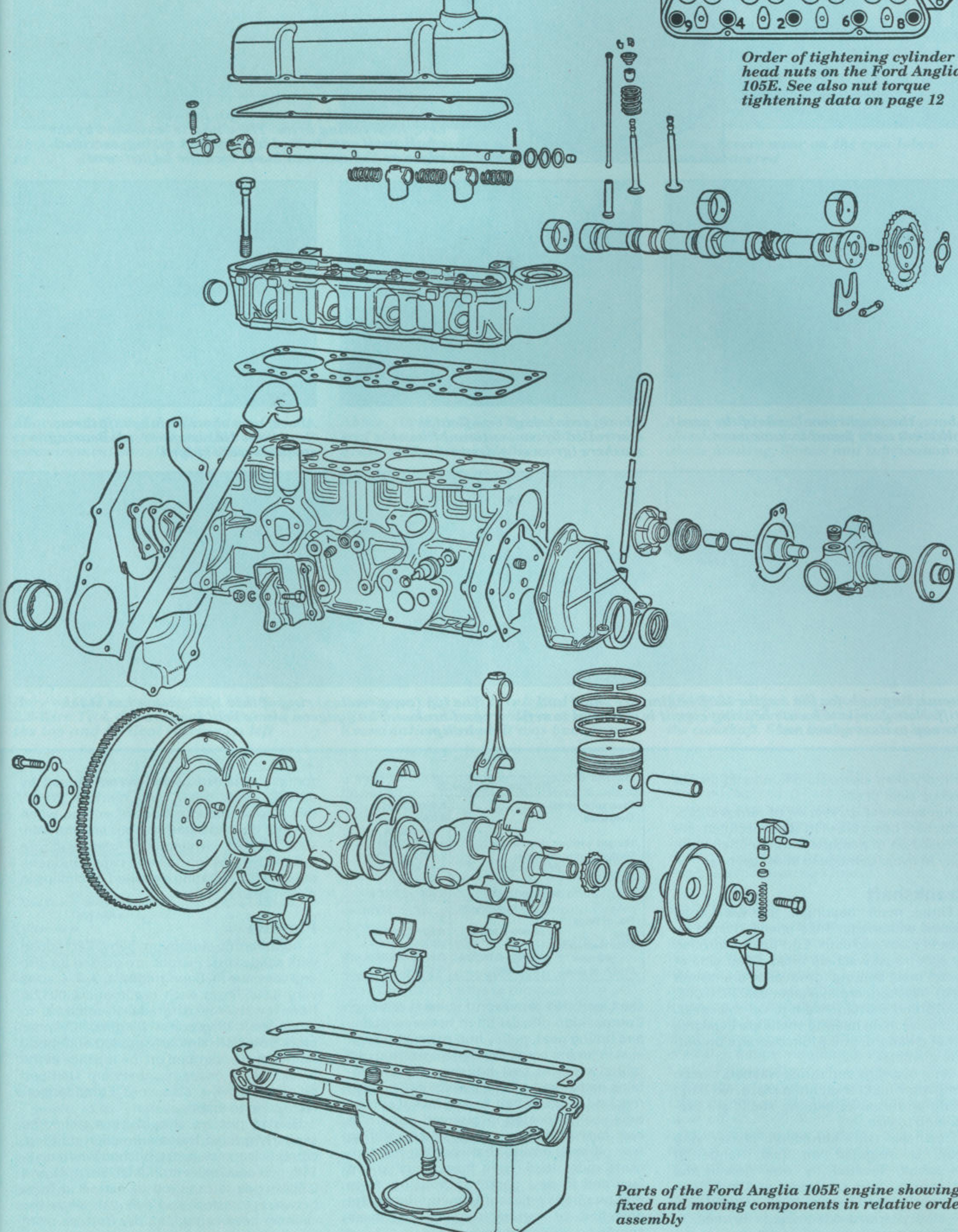
Remove starter motor unit – two retaining bolts, take off crankcase breather pipe and disconnect fuel feed pipe from lift pump. Unclip and remove distributor cap, disconnecting HT lead from coil and LT lead from CB terminal on distributor. Remove splash shield on front of clutch housing. Support gearbox on suitable platform or trolley jack and remove bellhousing bolts. If special lifting bracket is available (Tool No P6115) remove no 2 & 3 sparking plugs and 2nd and 4th cylinder head securing bolts on the left-hand side of head. Locate bracket ends in spark plug recesses and bolt bracket to cylinder head with bolts ½in longer than those removed. When bracket is not available, position rope sling around engine unit and support weight with suitable lifting tackle. Remove two bolts securing each engine mounting to the cross-tube, draw unit forward so that gearbox

ENGINE DATA	
General:	
Type	OHV
No of cylinders	4
Bore x stroke: mm	80.9625 x 48.41
in	3.1875 x 1.906
Capacity: cc	996.6
in^3	60.84
RAC rated hp	16.5
Max bhp at rpm (net): at 8.9:1 CR	39 at 5,000
Max torque at rpm: at 8.9:1 CR	52 lb-ft at 2,700
Compression ratio	8.9:1 std 7.5:1 opt

NUT TIGHTENING TORQUE DATA	
	lb/ft
ENGINE	
Cylinder head bolts	65-70
Main bearing bolts	55-60
Flywheel/crankshaft bolts	45-50
Big end bolts	20-25

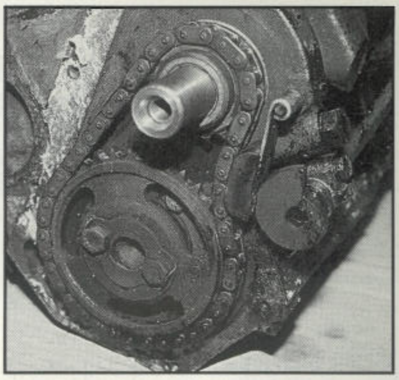


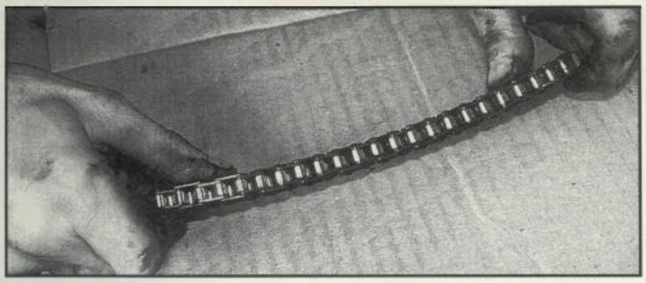
Order of tightening cylinder head nuts on the Ford Anglia 105E. See also nut torque tightening data on page 12



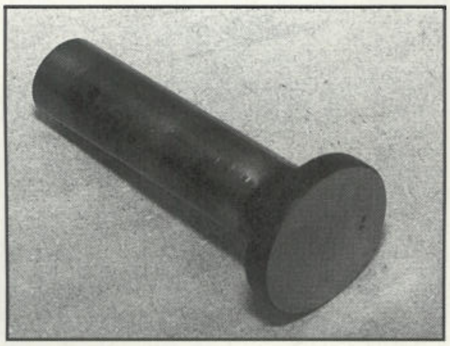
Parts of the Ford Anglia 105E engine showing the fixed and moving components in relative order of assembly

THE FORD 105E ENGINES

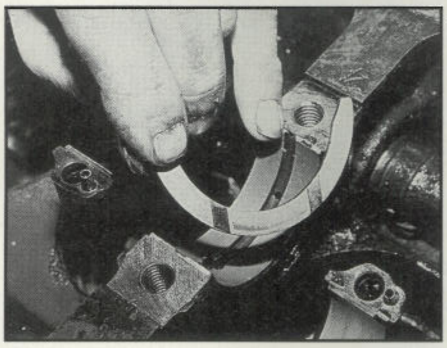




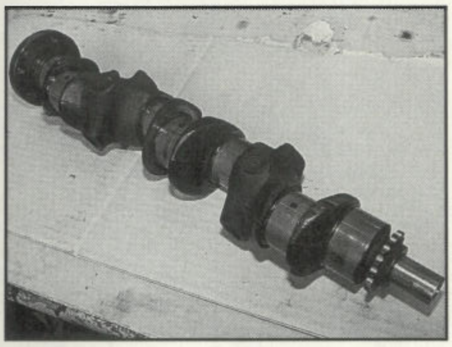
Above, testing the timing chain for wear
Left, 105E timing drive. The chain is tensioned by the small snail cam turned by a torsion spring; serrated edges on the cam and blade lock the adjustment



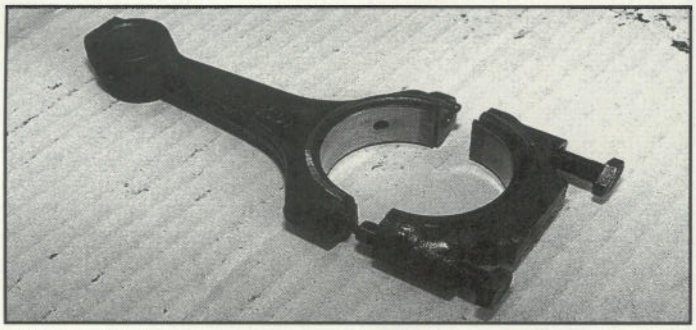
Above, the mushroom heads of the cam followers were found to have worn concave



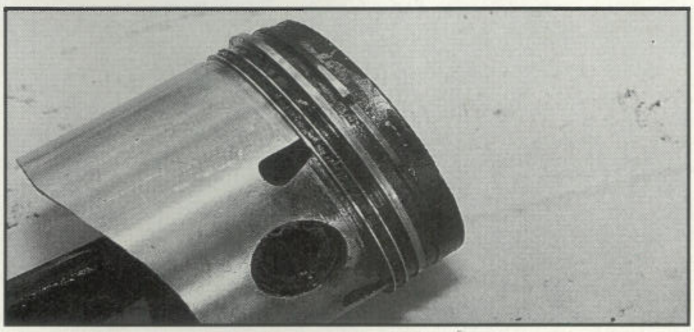
Above, crankshaft end-float is controlled by conventional thrust washers (grooved sides to shaft)



Above, very short crankshaft throw (less than 1in) is apparent. Bearing surfaces were ridged



Connecting rods for the Anglia 105E engine are short and stiff. Note dowels to locate bearing cap; it is essential to refit the cap to its original rod



The top (compression) ring of this 105E piston has stuck and broken. The gudgeon pin is held in place by circlips

primary shaft clears clutch unit and lift out and up clear of car.

Replacement is reversal of removal process, care being taken to see that clutch unit is eased on to gearbox primary shaft carefully to avoid damage to shaft splines.

Crankshaft

Three main bearings, thin-wall steel backed whitemetal lined shells located by tabs in block and caps. End-float controlled by split thrust washers fitted either side of centre main bearing (grooves to crankshaft web). Washers are available 0.0025, 0.005, 0.0075 and 0.010in oversize on thickness. Undersize main bearing shells are available either standard, or 0.015in oversize on outside diameter.

Main bearings and thrust washers can be removed with crankshaft in place. No hand fitting permissible, bearing shells are prefinished to size.

Flywheel, with shrunk-on starter ring gear, is spigoted on rear flange of crankshaft, located by one dowel and retained by four setscrews and lockplate. Oil-impregnated bronze bush pressed into flywheel, stepped side towards flywheel.

Timing sprocket, boss and timing marks to front and fan pulley keyed on front end of shaft with long single Woodruff key and retained by setscrew and large washer in shaft end. No provision for hand starting. Composition oil seal fitted between pulley and timing gear, pulley hub passes through seal in timing cover. Rear main bearing cap bolted up with seal housing, which contains half-round oil seal, which fits around rear end of crankshaft. Lower half of similar type seal is located in grooved portion in rear face of engine sump. When refitting rear oil seal, ensure that ends do not protrude more than 1/32 in from housing top face and fit new gasket to housing. Note that two bolts adjacent to sump flange are dowelled for correct location, and these should be tightened first.

PISTONS AND RINGS

Clearance (skirt)	0.0005-0.0011in	
Oversizes	0.030in available	
Weight without rings or pin	not quoted	
Gudgeon pin: diameter	0.8120-0.8123in	
fit in piston	zero to 0.0002in clear	
fit in con rod	0.0001-0.0003in	
	Compression	Oil Control
No. of rings	2	1
Gap	0.009-0.014in	0.009-0.014in
Side clearance in grooves	0.0016-0.0036in	0.0018-0.0038in
Width of rings	0.0775in	0.1555in

Connecting Rods

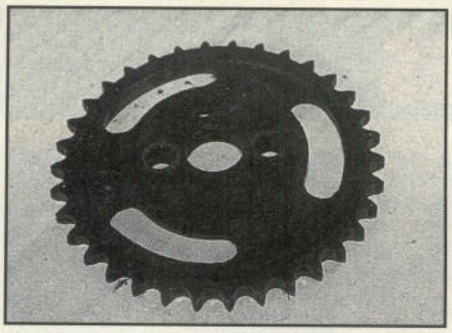
H-section forgings, big ends, split horizontally, retained by bolts and located by dowels. Rods offset, and marked 'Front', this side to show to front of engine when refitted. Big end bearing shells are thin wall, steel backed, whitemetal lined and are located by tabs in rods and caps. Gudgeon pins are fully floating, retained by circlips in piston bosses.

Pistons

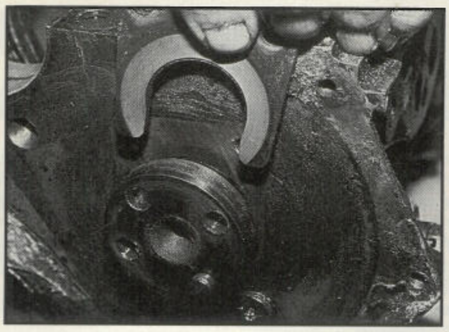
Autothermic aluminium alloy, flat topped with solid skirts. Pistons are graded for size and selective fit. Four grades, 1, 2, 3, 4, sizes vary 0.0003in in each grade and 0.0012in from lower limit of grade 1 (smallest) to upper limit of grade 4 (largest). Cylinder block bores are similarly graded and grade numbers are stamped on the top face of the block. Piston grade numbers are stamped on piston crowns, also word 'Front' for correct fitting to engine.

Graded pistons should be matched to similarly graded bores and when refitting, correct clearance is established when an 8-11lb pull on a feeler strip 0.0015in thick and 0.50in wide is required to extract it from between a piston and cylinder when the cylinder has been wiped dry from an oiled condition.

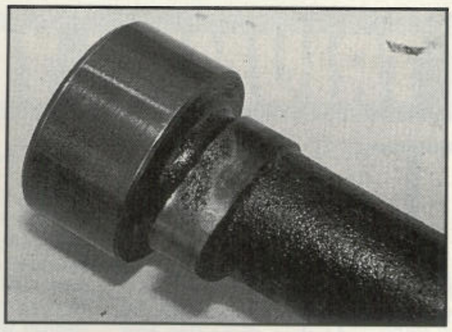
Two compression rings and one oil control ring fitted, all above gudgeon pin. Upper compression ring is chrome plated,



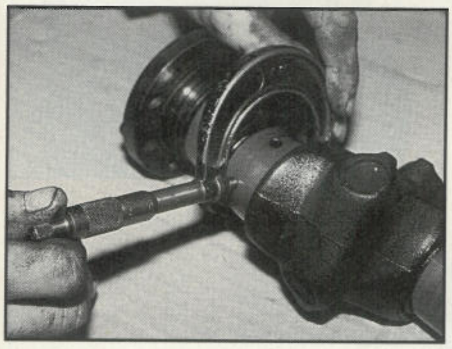
Above, chain wheel is located by dowel to . . .



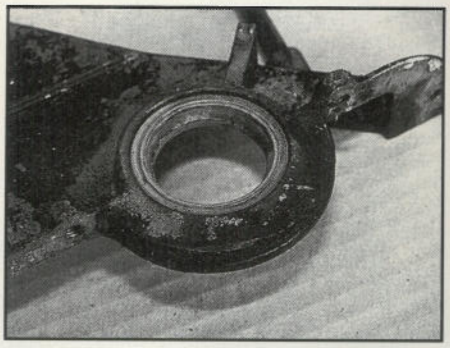
. . . camshaft, which is secured by this plate, controlling end-float



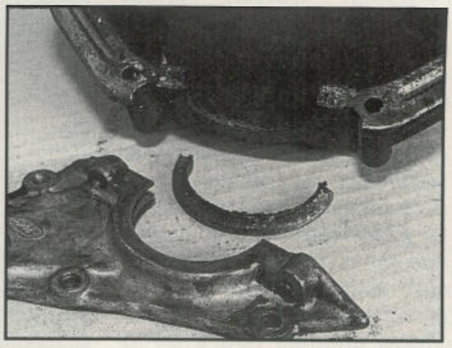
Above, severe wear on the cam lobes was discovered



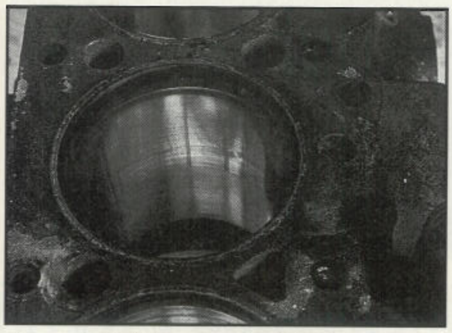
Above, measuring the diameter of a crankpin on the 105E crankshaft; measurement should be 1.9370-1.9375in



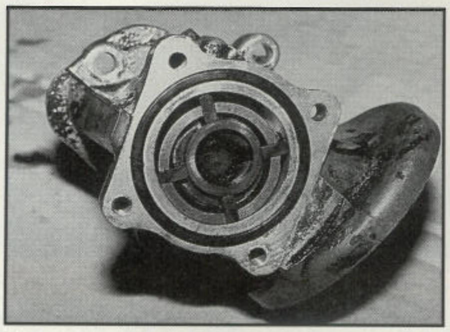
Above, timing cover. The crankshaft seal should be renewed and lubricated generously on reassembly



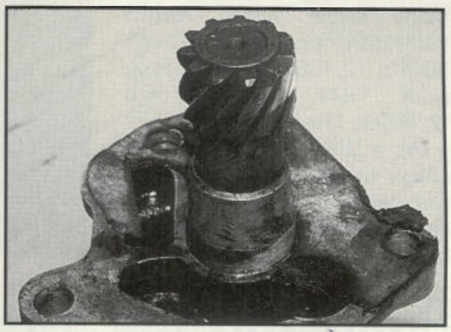
Above, crankshaft rear 'rope' seals should not protrude more than 0.032in above housing. Renew and lubricate



Bore of 105E is only slightly less than 2.2-litre TR4. Severe wear ridge near the top and vertical scoring on left



Vane-type oil pump is integral with filter head and externally accessible. Examination showed it was badly worn



This gear drives the vane-type oil pump and is itself driven by a skew gear on the camshaft. Some tooth wear can be seen

CRANKSHAFT AND CON-RODS

	Main Bearings	Crankpins
Diameter	not quoted	1.9370-1.9375in
Length	1.00in	1.062-1.064in
Running clearance: main bearings		0.0005-0.0020in
big ends		0.0005-0.0022in
End float: crankshaft		0.003-0.011in
big ends		not quoted
Undersizes		not quoted
Con rod centres		4.611-4.612in
No of teeth on starter ring gear/ pinion		not quoted

all rings are marked 'Top'. Pistons will not pass crank throws but big ends will pass through bores. Remove and reassemble through top.

Camshaft

Single roller endless chain drive. Camshaft sprocket spigoted on end of shaft, located by one dowel and retained by two setscrews with lockplate. Remove both sprockets with chain. Thrust plate trapped between front bearing journal and spigot and retained by two bolts and lockplate.

Camshaft runs in three steel-backed whitemetal-lined bushes pressed into housings in cylinder block. When renewing bushes ensure that oil holes are in line, no hand fitting required.

Valve timing marks on sprockets should be together and in line with centres when refitting. No fine adjustment for timing.

Valves

Overhead in-line, non-interchangeable, inlet longer than exhaust. Split-cone cotter fixings, single springs with close coils fitted to head. Umbrella oil seal fits around valve stems.

Valve guides plain, integral with head. Provision is made for reaming out 0.003in, and 0.015in to accommodate valves with stems oversize to these dimensions in service. After reaming, valve seats should be re-cut.

Tappets and Rockers

Plain mushroom tappets working directly in crankcase. Remove camshaft to extract.

Rockers, all unbushed and interchangeable, work on hollow shaft supported in four pillars, secured and located on cylinder head by hexagon-headed setbolts. Oil feed to shaft is through head drillings to no 1 (front) rocker pillar, radial holes drilled in rocker shaft for oilway to individual rocker arms. Rockers are assembled either side of pillars, separating springs between.

Adjuster screws fit in rocker ends, secured by locknuts and lower ends of screws are ball-shaped for location in upper cup ends of pushrods. End rockers are retained against pillars by split pins and each has two thrust washers and a spring cup washer. Pushrods may be removed singly after adjustment has been slackened right off but better to remove rockershaft complete for pushrod removal.

Lubrication

Gear-driven eccentric-rotor-type pump externally flange mounted to external oil filter element housing, which, in turn, is flange-bolted to engine crankcase. Pump unit comprises an inner and outer rotor, inner rotor is shaft driven by gear pinned to driveshaft end from skew gear on camshaft. Pump may be removed after withdrawal of flange mounting bolts, as unit for further dismantling, if necessary. Non-adjustable plunger and spring relief valve fitted in pump/filter housing. Valve set to blow off at 35-40 lb/in^2 and facia warning light indicates at low pressure of 5-7 lb/in^2. Normal running pressure may be less than blow-off pressure, no gauge fitted.

Cooling

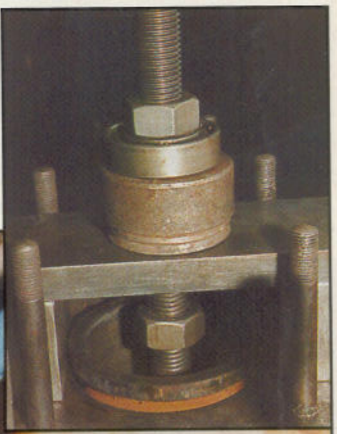
Pump, fan and thermostat. System is pressurised, thermostat retained in outlet elbow in cylinder head. Pump has spring-loaded carbon and rubber seal unit. Adjust fanbelt by swinging dynamo.

TRIUMPH TR2-TR4 ENGINES

THESE engines were derived from the Standard Vanguard unit introduced in 1948 which had a bore of 85mm and a stroke of 92mm giving a swept volume of 2,088cc. At this capacity the engine was also used in the Ferguson tractor. When developed as a sports car unit the capacity was reduced to put it in the under two litres category by fitting wet liners of 83mm bore, giving 1,991cc. Despite the reduction in capacity the power output was increased by 22hp from 68 to 90 by the use of a greater compression ratio, a rather 'livelier' camshaft and bigger valves. These engines had a good reputation as a reliable and long-lived unit even in hard-driven sports cars. Other bore sizes were 76mm (Standard Ensign, 1,670cc), 86mm (2,138cc, later TR3A and TR4), and 87mm (2,188cc, later tractors).

As a DIY overhaul proposition these engines should not present any great difficulty. The repairer needs to be aware of the wet-liner

Right, pulling a liner: A threaded rod is passed through the cylinder, bridged at the top by two blocks and a plate. At the bottom it passes through a stepped plug which is a snug fit in the bore on its smaller diameter and just below the outer diameter of the liner on its larger. A nut prevents the rod pulling through. The liner is drawn out by turning the top nut; use of a ball bearing makes turning easier.
Below, removing the liners allows them and the coolant jacket to be cleaned



TRIUMPH TR4 2,138cc MOTOR TRADER SERVICE DATA

Mounting

At front, bonded rubber blocks are inserted and bolted up between strengthened flanges either side of front engine plate and feet welded to chassis frame. Bracing bar is inserted horizontally to add rigidity to front mountings. Part of chassis, detachable to facilitate engine removal.

At rear, rubber block mounted to removable crossmember supports rear end of gearbox housing.

Removal

Engine and gearbox should be removed as unit, though it is possible to remove either component separately when occasion demands. To remove engine/gearbox as unit, proceed as follows: Take out bolts attaching bonnet to its hinges and remove it completely. Drain coolant, remove radiator cowl and radiator matrix, which is held by one large bolt (½in) at either side of the baseplate flange. Remove steady straps from top of radiator, disconnect hoses and thermometer and take out radiator core. Disconnect and remove front tubular crossmember (three bolts either end). Remove carburettors and manifolds and disconnect all pipes, wires and controls to engine/gearbox unit from car interior or from adjacent components. If overdrive is fitted, disconnect wire to solenoid switch on dash and to switch on gearbox. Disconnect pipe at tank to prevent fuel draining by siphon action from rear-mounted fuel tank when pipes are uncoupled at fuel pump. Release steering unit U-bolts and steering column. Move unit forwards.

Take out floor centre section and unscrew gearlever, first removing cover housing which is held *in situ* by long, screwed pinbolt. Uncouple front propeller shaft flange, and take weight of engine/gearbox unit on suitable slings or lifting tackle arranged around fan pulley boss and rear of unit.

ENGINE DATA	
General	
Type	OHV
No of cylinders	4
Bore x stroke: mm	86 x 92
in	3.386 x 3.622
Capacity: cc	2,138
in^3	130.5
RAC rated hp	18.3
Max bhp at rpm	100 at 4,600
Max torque at rpm	1,520lb-in at 3,350
Compression ratio	9:1

Remove rear mounting and crossmember and also steady bracket. Remove front engine mountings taking weight of unit, tilt engine upwards and lift out to front of car.

Cylinders

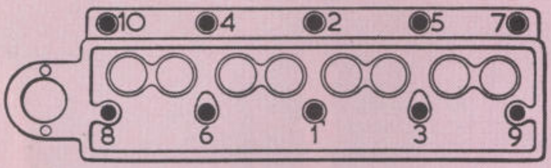
Wet replaceable cast iron liners, located by machine faces on upper and lower projecting bosses which abut against cylinder block casting. Thin 'spectacle' washers (one for each pair) fit between lower flange and block. When refitting use jointing compound on underside of washer only. Liners must stand proud of top face of block 0.003-0.005in.

When removing cylinder head, do not turn engine over to break joint as this practice is liable to break bottom joints. When head is off, clamp liners down in pairs by washers and distance-pieces on two studs.

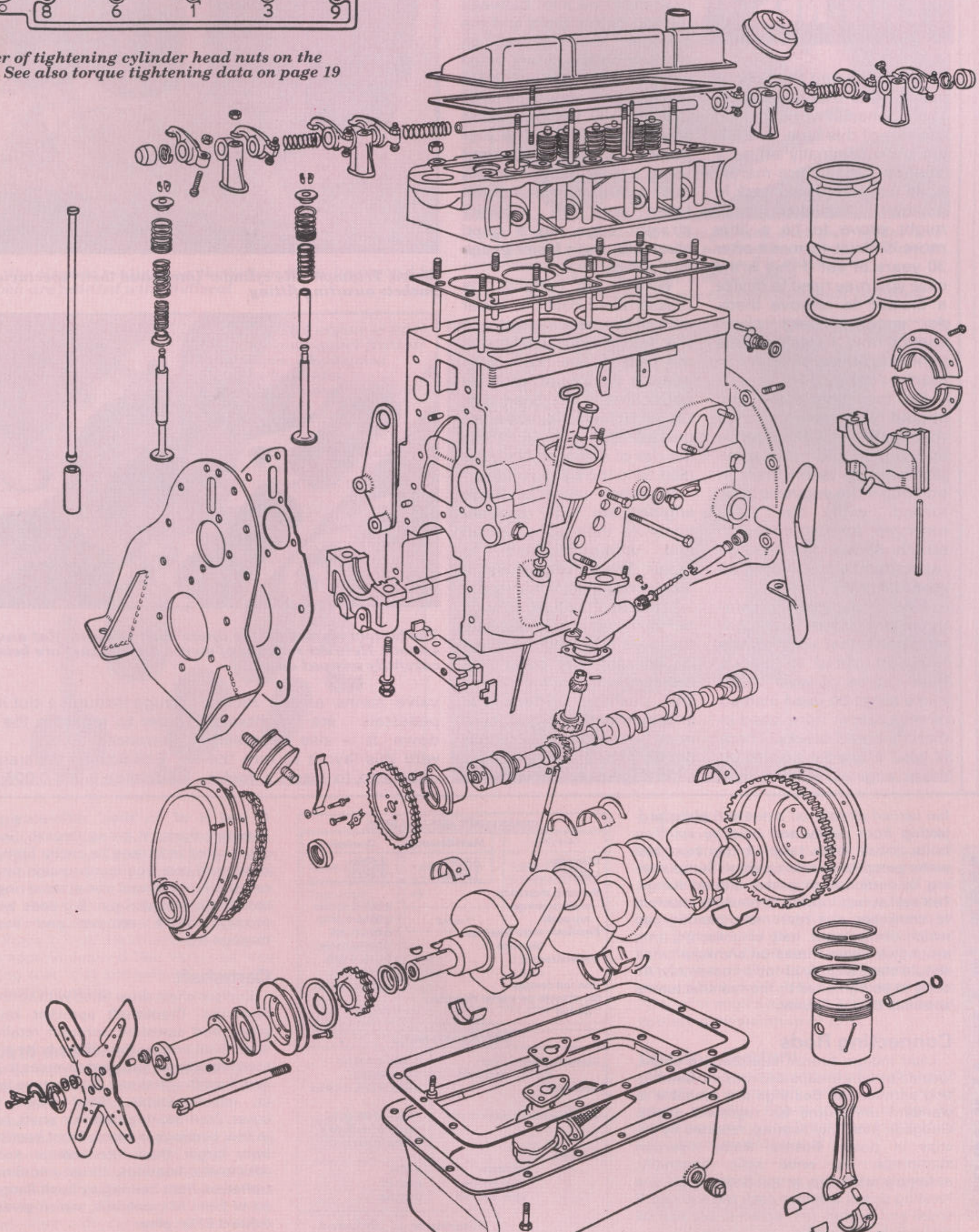
Crankshaft

Three main bearings, whitemetal thin wall lead-lined, steel-backed shells located by tabs in caps. No provision for hand fitting. Bearings are supplied in three nominal undersizes, 0.010, 0.020 and 0.030in for reground shafts. End-float controlled by split thrust washers fitted either side of centre main bearing. Bottom halves of washers tabbed to locate in centre bearing cap. Setscrew size ½in. Tighten fully to torque figures shown. All except rear main bearings may be changed without removal of shaft. Flywheel spigot mounted and attached to crankshaft by four ⅜in bolts and is dowel located in flange. Bolted starter ring gear fitted, centre bush pressed in.

Timing sprocket keyed to front end of crankshaft by Woodruff key; aligning shims abut against inner boss of sprocket. Oil seal pressed into timing case cover, replaceable. Dynamo drive pulley keyed to crankshaft by outer of two Woodruff keys, and four-bladed



Order of tightening cylinder head nuts on the TR4. See also torque tightening data on page 19



Parts of the Triumph TR4 engine and ancillary components showing relative order of assembly

TRIUMPH TR2-TR4 ENGINES

construction and the special precautions that are necessary when working on engines of this type. The liners were originally an easy 'slip' fit – they were merely lifted out and placed back in position; however, they might prove to be a little more difficult to move after 30 years or so! If this is the case you may need to devise a drawer to remove them. An accompanying photo shows how I dealt with a similar problem on an Aston Martin engine.

On the other hand you should you *never* assume that the liners will not move and you should make some provision to retain them in position if the engine is to be turned with the head removed. An accompanying sketch shows the method recommended by the engine manufacturer.

One of the main advantages of the wet-liner construction is that a high-grade iron formulated to give a high degree of wear resistance could be used instead of the cheaper irons used in directly-bored blocks. There is also a special bonus on these engines in that they are designed so that after a longish period of use, perhaps 50,000 miles, the liners can be turned through 90° to equalise bore wear.

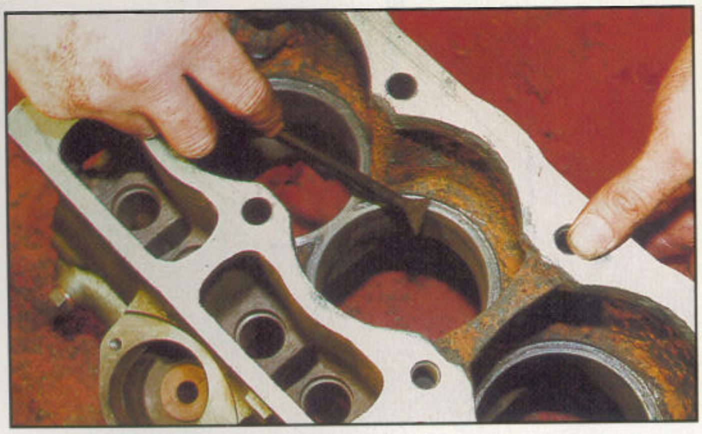
In order to produce a good high pressure joint between the top of the liners and the cylinder head gasket on reassembly,the liners must protrude 0.0035in-0.005in ($3\frac{1}{2}$-5 'thou') above the head face. Ideally the protrusion should be 0.004in. The protrusion is best measured using a clock gauge but at a push a *careful* measurement taken with an accurate straight edge (eg a good steel rule) and a feeler gauge will suffice.

When the engine is reassembled coat the lower side of the head gasket and the 'figure eight' gaskets at the base of the liners with jointing compound and the upper side of the head gasket with high-melting-point grease, this will minimise the risk of a liner moving the next time the head is lifted.

In other respects these engines are fairly conventional in their construction and straightforward to repair. The valvegear was a little unusual in some applications in that two springs per valve were used but only the inner one held the valve on its seat, the outer one merely returned the rocker and pushrod. Where this arrangement is used care must be taken to ensure that the holes in the outer spring caps align properly with the valve stems as the rocker pedestals are tightened down. It is also necessary with this layout to turn the outer cap to insert a feeler gauge through a slot in it, in order to measure the valve clearance.

End-float on the crankshaft should be 0.004-0.006in.

Above, Triumph TR4 cylinder liners and their 'spectacle' gaskets awaiting fitting



The bottom seating for the liners must be clean, flat and smooth. Here the remains of an old liner gasket are being carefully scraped away

TRIUMPH TR4 2,138cc

fan carried directly on extension piece projecting from pulley and held by six $\frac{5}{16}$in bolts. V-belt drive taken to dynamo and water pump from crank pulley. Sump sealing by composition gasket around flange. Felt seal at rear located in housing attached to crankcase and rear main bearing cap which forms lower half of collecting ring around oil return thread on crankshaft. Felt should stand slightly proud on assembly. All bolts to be tightened to the manufacturer's specified torque figures.

Connecting Rods

Lead indium bronze steel-backed shells, located by tabs in caps and rods, no hand fitting permissible. Bearings are available in standard undersizes for reground shafts. Gudgeon pins fully floating, retained by circlips in piston bosses. Rods H-section stampings, big ends split diagonally; assemble with cap to nearside; note: one locating dowel between each rod and cap. If small end bushes are replaced, see that oil drillings are aligned.

Pistons

Aluminium alloy, flat topped, diagonally split skirt. Available in three fitting grades, F, G and H of $\frac{4}{10}$ 'thou' difference in size between them, H being largest. Gudgeon pin located in bosses by circlip fitting. Two butt-faced cast iron compression rings and one scarf jointed cast iron scraper ring all fitted above gudgeon pin. Big ends will pass through bores, remove and assemble through top.

CRANKSHAFT AND CON-RODS		
	Main Bearings	Crankpins
Diameter	2.479in	2.086in
Length	1.745in	0.967in
Running clearance:		
main bearings		0.001-0.0025in
big ends		0.0016-0.0035
End-float: main bearings		0.004-0.006
big ends		0.007-0.014in
Undersizes		0.010, 0.020, 0.030in
Con rod centres		6.250 ± 0.002in
No of teeth on starter ring gear/ pinion		117/10

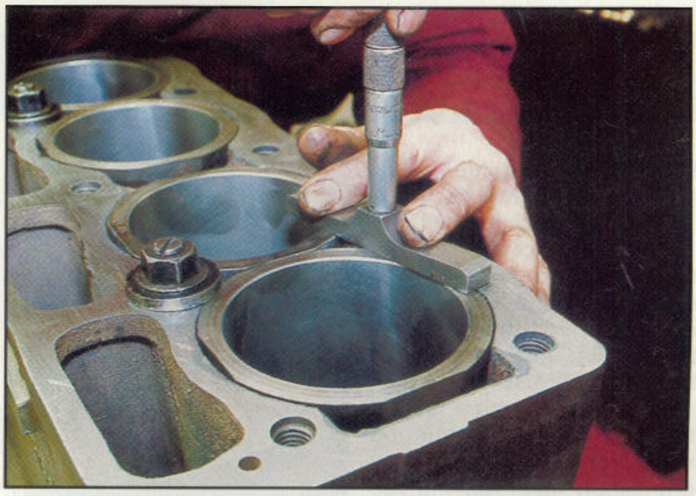
PISTONS AND RINGS		
Clearance (skirt) (top)	0.0054-0.0057in	
(bottom)	0.0032-0.0037	
Oversizes	0.010, 0.020, 0.030in	
Weight without rings or pin	Weight tolerance must not exceed 4 drams in set of 4.	
Gudgeon pin:		
diameter	0.85in	
fit in piston	push fit	
fit in con rod	floating	
	Compression	Oil Control
No of rings	2	1
Gap	0.003-0.010in	0.003-0.010in
Side clearance in grooves	0.001-0.003in	0.001-0.003in
Width of rings	0.062in	0.156in

Camshaft

Endless chain drive fitted with spring-type tensioner. Crankshaft sprocket keyed in place, and camshaft sprocket retained on shaft front end by four offset bolts giving $\frac{1}{2}$ tooth variations; sprocket reverses to give $\frac{1}{4}$ and $\frac{3}{4}$ tooth variations. Spring type tensioner, non-adjustable, fitted inside timing cover. Four-bearing cast iron shaft, running in four bearings in block. Front bearing cast iron, larger than intermediate and rear whitemetal bearings, thrust end-float controlled on front bearing by bush flange bolted to front of crankcase, which gives from 0.004-0.012in play.

To time engine, set crankshaft to TDC (1 and 4 pistons, no 1 firing). Check with dial or depth gauge, or flywheel mark. No 7 and 8 valves on rock. Line up marks on camshaft sprocket, attach chain and replace cover.

Above, the cleaned seatings on the bottom of the liners and in the block are painted with Wellseal

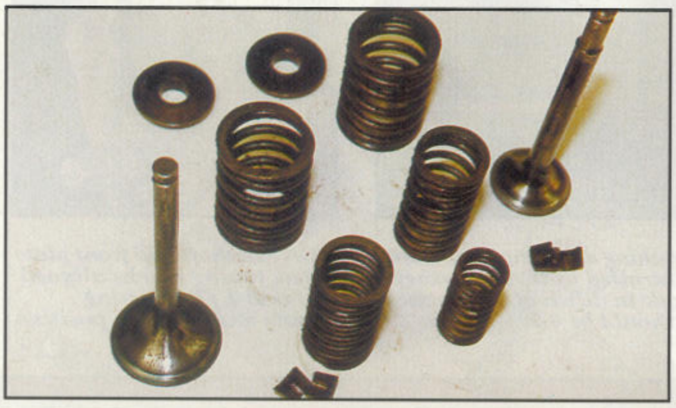


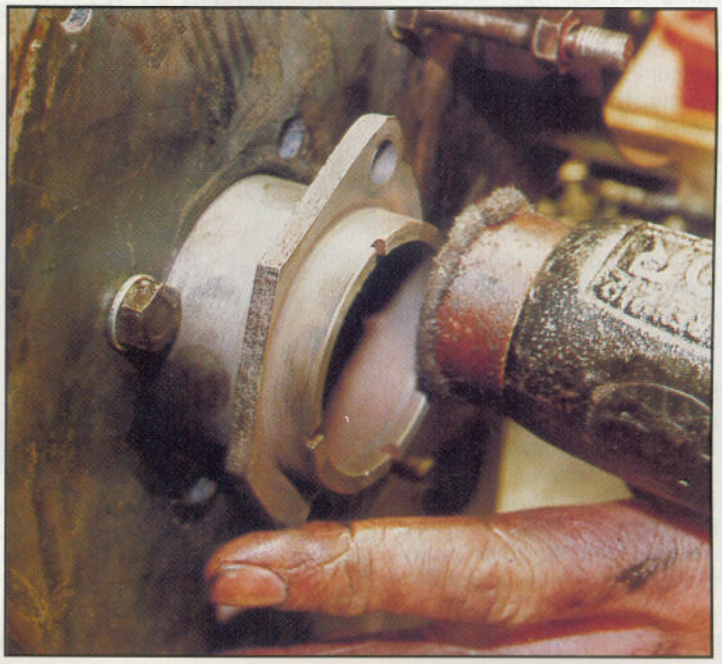
Above, after assembly with new gaskets, each pair of liners is secured by a short stud with a nut and heavy washer. Here a micrometer depth gauge is being used to check liner protrusion, which should be 0.0035-0.005in

Below, the front bearing/sleeve controls camshaft end-float

Left, the TR4 engine is fairly conventional apart from its wet liners. Flat-topped pistons have two compression and two oil control rings

Below TR4 exhaust valves have three springs each, inlet valves have two





Valves

Overhead, in line, non-interchangeable, inlet larger than exhaust. Split-cone cotter fixing, double springs to inlet valves, triple springs to exhaust. Springs located on stepped collar on cylinder head around guides. Valve guides plain, inner end chamfered. Press in until the chamfered end protrudes approximately 0.78in from spot face of spring seat. Inlet and exhaust guides are non-interchangeable.

VALVES		
	Inlet	Exhaust
Head diameter	1.558-1.562in	1.299-1.303in
Stem diameter	0.310-0.311in	0.3705-0.3715in
Face-angle	45°	45°
	Inner*	Outer
Spring length:		
free	2.08in	1.98in
fitted	1.45in	1.56in
at load	33lb**	38lb

*Auxiliary inner spring exhaust: Free length 1.54in, fitted length 1.14in, at load 10lb
**Exhaust valve aux inner spring 36.5lb

Tappets and Rockers

Plain barrel type tappets sliding directly in crankcase. Remove from top with long-nosed pliers. Pushrods may be taken out after removal of rocker shaft; mounted in four pedestals, three coil springs separating rockers on inner sides of posts. Shaft located by dowel bolt in rear pedestal. End rockers retained by double coil spring washers and pinned caps. Rockers left- and right-handed (inlet and exhaust), interchangeable, phosphor bronze bushed. Oil feeds from camshaft by drillings to cylinder head and end rocker pillar, which is drilled to take oil supply to hollow rocker shaft, and thence by radially drilled holes to rockers.

NUT TIGHTENING TORQUE DATA		
ENGINE	Bolt size (in)	lb-ft
Cylinder head stud nuts	1/2 UNF	100-105
Con-rod caps	7/16 UNF	55-60
Engine plate and timing front cover	5/16 UNF	12-14
Flywheel/crankshaft	5/8 UNF	42-46
Main bearing caps	1/2 UNC	85-90
Rocker pedestals	—	24-26
Flywheel ring gear	5/16 UNF	16-18

Motor Trader ***data above is specific to the TR4.***

Lubrication

Hobourn-Eaton eccentric rotor pump, spigoted and flange bolted to bottom of crankcase. Separate driveshaft runs in long bronze bush in crankcase, flanged and pressed in from top. Oil is delivered to bearings from pump and from rear camshaft bearing to rocker gear. External filter is full flow type. Adjustable spring-loaded ball relief valve on filter body adjusted by grub-screw and locknut. Normal pressure set to 70lb/in^2 at engine speed of 2,000rpm and an operating temperature of 70°C.

Cooling System

Pump, fan and thermostat. Fan mounted directly on crankshaft pulley driving water pump impeller. Adjust tension of belt by swinging dynamo on bracket so that there is 3/4in play in longest run of belt.

Classic Cars ***can accept no responsibility for consequences arising from use of the data and procedures given in this supplement.***

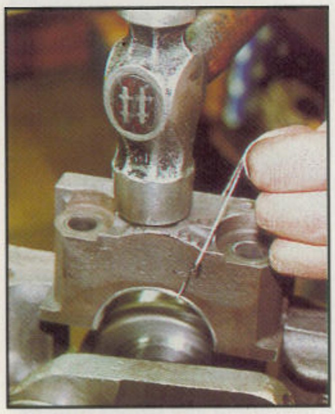
THE MGB ENGINE

THE Austin/BL 'B' series engine is a good one for the beginner to cut his teeth on and an excellent example of the 'B' series in its developed form is that fitted to the later versions of the popular MGB.

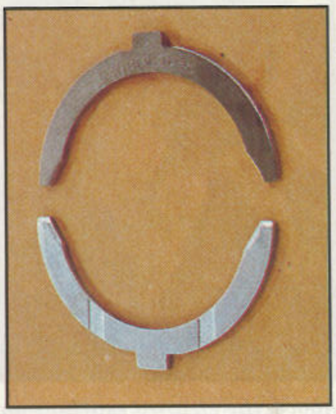
One of its virtues is that the crankcase is continued downwards, well below crankshaft level making the engine structure stiffer than would otherwise be the case. It also makes for a freedom from oil leaks as the sump has a simple flat face and a single gasket, so that the use of curved seals, which cannot be clamped evenly, is avoided. There is sometimes a small associated problem, that of removing the front and rear main-bearing caps; this can generally be achieved by unscrewing the two bolts completely and then pinching them together to grip the cap so it can be wiggled out.

This method is not infallible; the 'official' way of dealing with the problem is to use a special adaptor, screwing into a tapped bolt hole, in conjunction with a slide hammer, to 'shock' the cap out of place. Another possibility is to screw a longer-

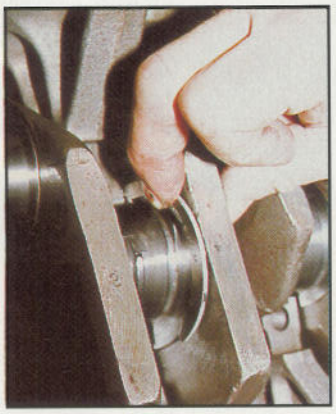
Above, fitting main bearing shells. Engage lugs in their 'nibs' and push the shells home



Above, fitting rear main bearing cap. The string prevents the shell falling as the cap is tapped home

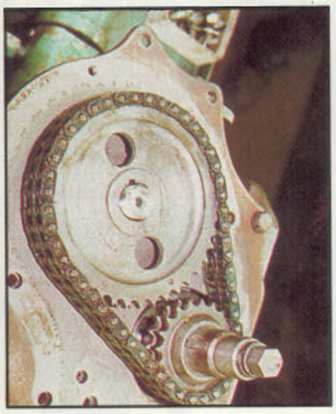


Above, thrust washers. The grooved whitemetal side (bottom) must be towards the crankshaft



Centre main bearing thrust washers (no lugs on upper ones) are fed into place. Turning crankshaft may help

Checking crankshaft end-float, controlled by thrust washers made in different thicknesses. It should be 0.004-0.005in



MGB camshaft and front plate fitted, timing marks aligned at 1 and 4 TDC, timing wheels and chain in position

MGB 1,798 cc — MOTOR TRADER SERVICE DATA

Mounting

At front, mounting rubber blocks are bolted up to frame brackets which are in turn bolted up to engine plate flanges. Lower portion of each mounting bracket is bolted to crankcase side direct, and mounting plates are bolted to body sidemembers.

At rear, tailcase of gearbox rests in cradle of mounting crossmember which is bolted up between chassis frame members. Bonded rubber mounting blocks are bolted up to cradle mounting bracket abutments by one bolt each and to gearbox bosses by two bolts each. Additional stay rod bolted up to chassis frame member at one end and clevis bolted to gearbox extension at the other. Tighten all bolts and nuts fully.

Removal

Engine may be removed from car, with or without gearbox. To remove with gearbox, proceed as follows:

Disconnect batteries and take off bonnet. Drain oil from engine and gearbox and coolant from engine and radiator. Disconnect oil cooler and oil pressure gauge pipes from engine, also top and bottom radiator hoses. Take off oil cooler securing bolts. Take out radiator and diaphragm

ENGINE DATA

General		
Type		18G, 18GA
No of cylinders		4
Bore x stroke: mm		80.26 x 89
in		31.6 x 3.5
Capacity: cc		1,798
in^3		109.8
Max. bhp at rpm		92 at 5,300
Max. torque (lb-ft) at rpm		106 at 3,000
Compression ratio	HC	8.8:1
	LC	8.0:1

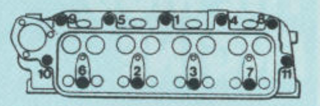
assembly complete with oil cooler and pipes.

Disconnect and remove all pipes, wires, drive cables and controls to and from engine and ancillary components. On synchro/overdrive models, remove gearlever surround, raise rubber boot and unscrew and remove lever retaining bolts and take out gearlever. Disconnect wiring from reversing light and overdrive isolation switches. Detach clutch slave cylinder from gearbox casing and tie up out of way. On automatic drive models, disconnect downshift cable from carburettors and manual control lever from transmission shaft, together with wiring from inhibitor and reverse-light switch.

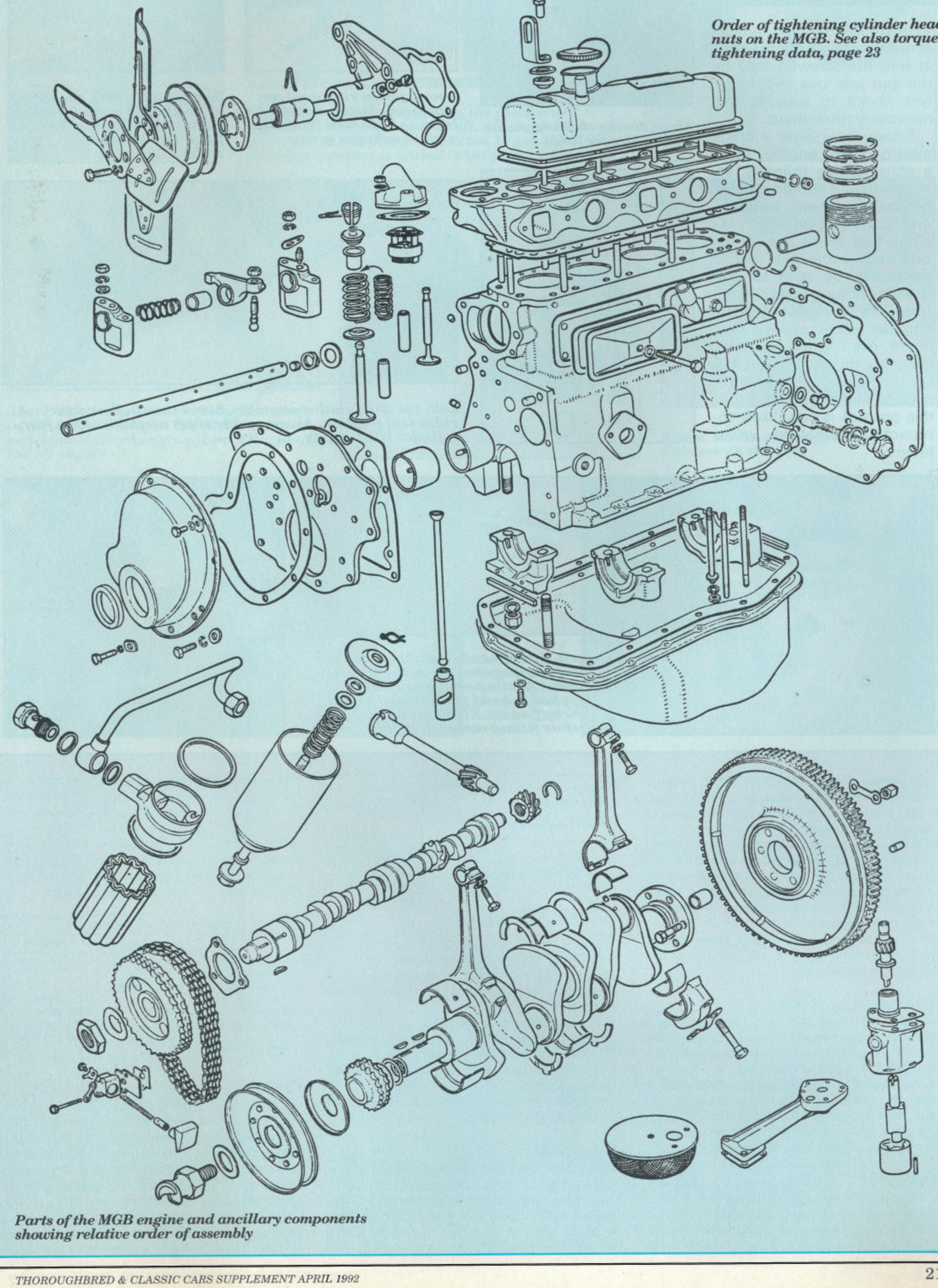
On all models, withdraw speedo drive cable from gearbox and take weight of engine on suitable crane and support gearbox. Disconnect exhaust pipe at manifold junction and release pipe clip from gearbox. Undo and remove propeller shaft and take out bolts securing engine front mountings to frame. Take out four bolts securing crossmember to chassis frame, and two bolts which secure bottom tie bracket to crossmember. Lower gearbox so that it rests on fixed crossmember, remove mounting nuts and take out crossmember. Ease assembly forward until gearbox is clear of crossmember, tilt assembly and lift from car.

Crankshaft

Five main bearings, thin-wall, steel-backed, copper-lead lined shells located by tabs in bearing caps. End-float controlled by split thrust washers either side of centre main bearing, and lower halves retained by tabs in cap. Fit with oil grooves to crankshaft. No hand fitting permissible. Main bearings may be changed without removal of shaft. Flywheel spigot mounted and flange bolted to crankshaft by six bolts and nuts. Spigot bush, renewable, pressed into crankshaft end, shrunk-on starter ring



Order of tightening cylinder head nuts on the MGB. See also torque tightening data, page 23

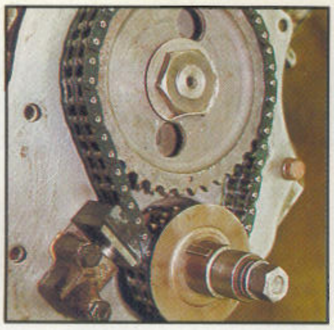


Parts of the MGB engine and ancillary components showing relative order of assembly

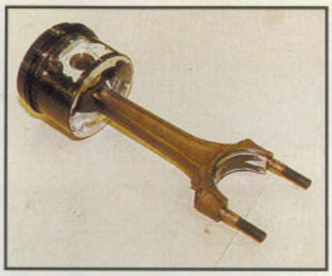
THE MGB ENGINE

than-standard high-tensile screw carrying a plain washer into the screwed hole in the cap and use two large tyre levers to provide the necessary movement.

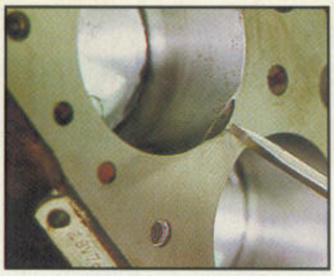
Rocker gear wear is common on these engines after a considerable mileage, so at overhaul it should always be broken down carefully and examined. On some versions two shims are fitted, one each under two rocker pedestals; be sure to put them back where they came from. The valvegear of these engines can always be heard even when in first-class condition. Do not be tempted to reduce the clearance to quieten it further as this practice is very likely to provoke premature valve failure.



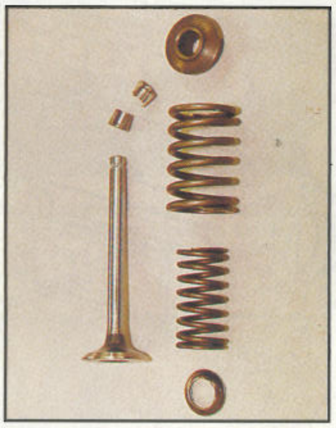
Above, timing chain tensioner and oil slinger fitted

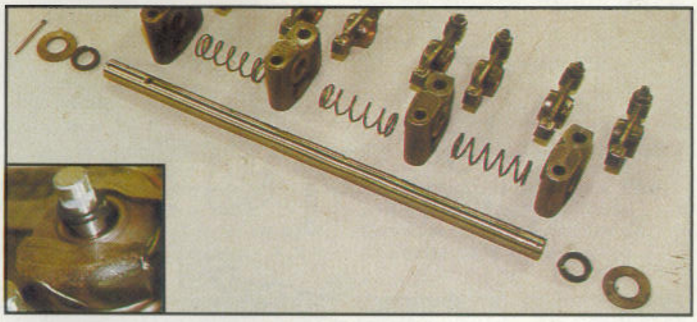


Above, piston ring gaps are staggered. Piston and shell bearing have been lubricated with Graphogen grease

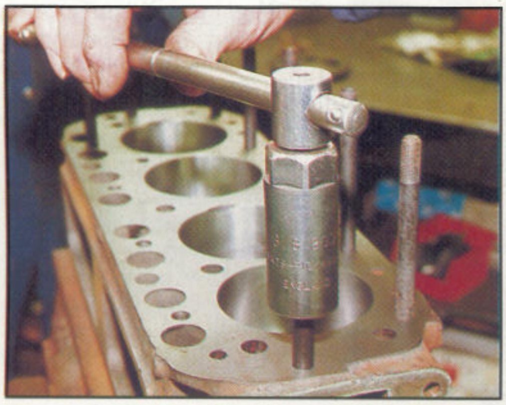


Above, piston ring gaps must be positioned away from this cutout when the pistons are fitted into the bores

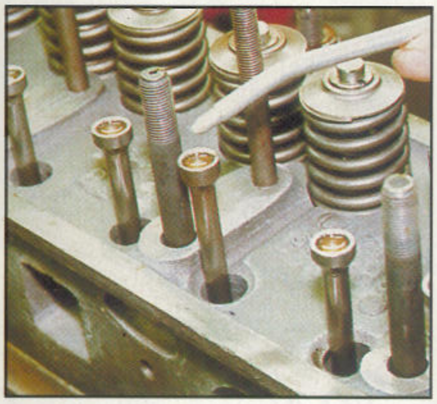




Left, the MGB's valve assembly. Above (inset), the correct valve seal position. Above, rocker shaft assembly of the four-cylinder MGB engine



Left, fitting head studs; there are two lengths, long ones go on the nearside. Above, jointing compound being applied to head gasket; card avoids sticky fingers. Right, oiling pushrods before fitting rocker assembly



MGB 1,798 cc

gear fitted. Timing sprocket keyed to front end of crankshaft by inner of two Woodruff keys, aligning shim abuts against boss of sprocket. Renewable oil seal pressed into timing case cover. Dynamo and water pump drive pulley keyed to crankshaft by outer of two Woodruff keys, retained by starter dog screw. Sump sealing effected by composition gasket around flange and two square-section seals at rear, either side of main bearing cap, which forms lower half of collecting ring around oil return thread on crankshaft.

Connecting Rods

Big ends offset, thin-wall bearings, steel-backed, copper-lead liners located by tabs in rod caps. No hand fitting permissible. H-section rods split horizontally.

Assemble rods with locating tabs mating and oil bleed hole in longer side of rod shoulder away from camshaft. Gudgeon pins are bolt-clamped in split small ends, clamp bolts fitted towards camshaft.

Pistons

Aluminium alloy, dished crowns and solid skirt type. Pistons supplied for selective assembly and oversize dimensions are stamped in an ellipse, together with word

CAMSHAFT	
Drive type	Chain and sprocket
Bearing journal diameter:	
Front	1.7887-1.78925
Centre	1.72875-1.72925
Rear	1.62275-1.62325
Bearing clearance (diametral)	0.001-0.002in
End float	0.003-0.007in
Cam lift	0.250in
Timing chain: pitch	3/8in
no of links	52

'Front' on piston crowns. When reboring, ensure that oversize dimension of bores is stamped in prominent position on cylinder block face.

Top piston ring (compression) plain, 2nd and 3rd rings are taper faced and marked 'T' (top) for correct assembly. All rings, including scraper ring, are fitted above the gudgeon pin.

Oversize pistons available for service as in table of Piston Data.

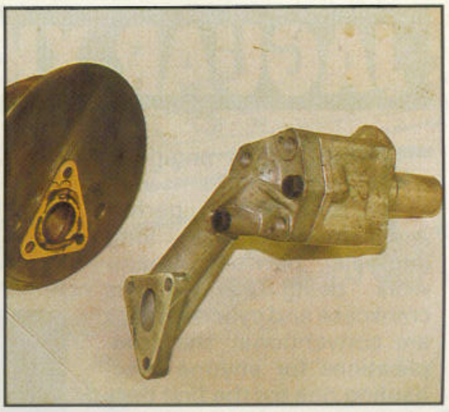
Camshaft

Double row roller endless chain drive. Spring-loaded helix and neoprene slipper-type tensioner bolted to crankcase. Chain slack is taken up by increase of spring pressure on slipper as helix unwinds. Chain wheel is keyed to front end of shaft and retained by lock tab and nut. Camshaft runs in three whitemetal-lined, steel-backed bearing shells which are pressed direct into block. End-float controlled on front bearing. Dot punch marks on both driving and driven wheels indicate correct timing and must be together, engine at TDC no 1 cylinder on compression, when chain is fitted.

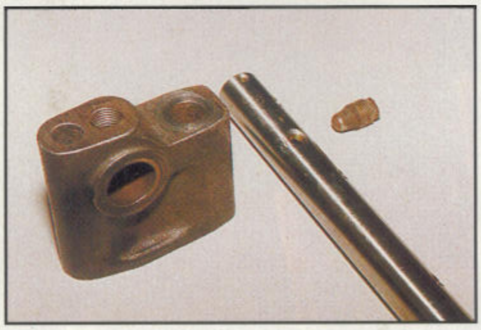
CRANKSHAFT AND CON-RODS		
	Main Bearings	Crankpins
Diameter (in)	2.1262-2.127	1.8759-1.8764
Running clearance:		
main bearings (in)	0.001-0.0027	
big ends (in)		0.001-0.0027
End-float: crankshaft (in)		0.004-0.005
Undersizes (in)		0.010-0.020, 0.030 and 0.040
Con rod centres (in)		6.5

Valves

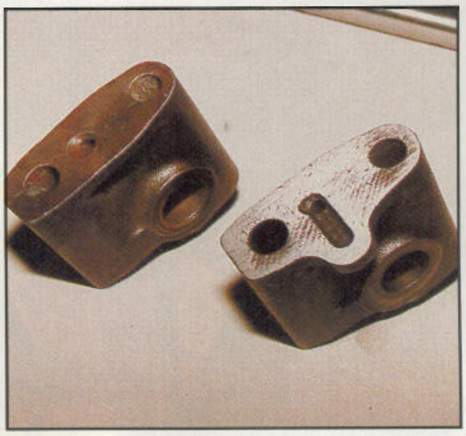
Overhead, non-interchangeable. Inlet larger than exhaust, split cone cotter fixings, retained by spring clips. Rubber sealing rings with retainers on valve stems below collars. Valve guides plain, no shoulder, non-interchangeable, exhaust guides counter-bored at bottom and both types countersunk at top. Exhaust guides are larger than inlet guides. When renewing, guides should be pressed or driven in from



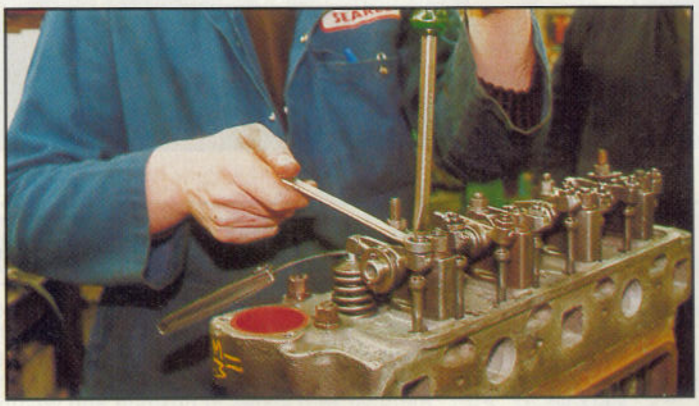
Left, using a ring compressor, the pistons are tapped in with a hammer shaft. Above, the drive pinion for the oil pump is inserted. Right, the MGB's oil pump strainer is sealed to the pump body



Above, this screw locates the rocker shaft in the pedestal. Right, old (left) and new pedestals. Interchanging them will cut off the oil supply



Above, serviceable tappet/cam follower on the left



Left, after fitting rockers and torqueing down head, valve clearances are set

Right, with no 1 cylinder at TDC firing, insert the distributor driveshaft in this position, larger offset to bottom

VALVES		
	Inlet	Exhaust
Head diameter	1.562-1.567in	1.343-1.348in
Stem diameter	0.3422-0.3427in	0.3417-0.3422in
Face-angle	$45^{1}/_{2}$°	$45^{1}/_{2}$°
Overall length (guides)	$1^{7}/_{8}$in	$2^{13}/_{64}$in
	Inner	Outer
Spring length:		
free	$1^{31}/_{32}$in	$2^{9}/_{64}$in
fitted	$1^{7}/_{16}$in	$1^{9}/_{16}$in
at load	28-32lb	72lb
Valve crash speed	6,200rpm	6,200rpm

top until they project $^{5}/_{8}$in from machined surface of valve spring seat.

Valve guides. Projected $^{5}/_{8}$in before the following numbers:–

18GA-U-H 11927
18GA-RU- 11150
18GA-RU-L 9710
18GA-U-L 8313

After the above numbers, projected $^{3}/_{4}$in except 18GA-U-H 12001 to 12175 inclusive.

Tappets and Rockers

Shouldered barrel-type tappets sliding direct in crankcase. Access obtained through side openings in crankcase. Bushed rockers, all interchangeable, are

PISTONS AND RINGS		
Clearance (skirt) (top) (in)		0.0036-0.0045
(bottom) (in)		0.0018-0.0024
Gudgeon pin:		
diameter (outer) (in)		0.77499-0.7501
fit to piston		free at 20°C
fit to con rod		semi-floating
	Compression	Oil Control
No of rings	3	1
Gap	0.012-0.017in	0.012-0.017in
Side clearance in grooves	0.0015-0.0035in	0.0016-0.0036in
Width of rings	0.0615-0.0625in	0.1552-0.1562in

mounted on shaft carried in four pillars on cylinder head. Shaft located by grubscrew and lockplate on top of no 4 (rear) pillar, which is drilled for oil feed through drillings in head and cylinder block. Pairs of rockers for each cylinder are positioned each side

NUT TIGHTENING TORQUE DATA	
	lb-ft
ENGINE	
Main bearing nuts	70
Gudgeon pin clamp bolt	25
Big end bolts	35-40
Cylinder head nuts	45-50
Sump to crankcase	6
Water pump to crankcase	17
Manifold nuts	15
Oil filter centre bolt	15
Clutch to flywheel	24-30
Carburettor stud nuts	2

of each rocker pillar and are located by separating springs between rockers of adjacent cylinders.

Pushrods may be removed after tappet adjusting screws have been slackened right off. Inner rockers may then be pulled aside against separating springs. End rockers must be taken off, after removal of split pin, plain washer, double coil spring washer.

Lubrication

Eccentric-type pump spigoted in recess at rear of cylinder block and driven by slotted shaft from skew gear at rear end of camshaft. Pump may be removed after taking off sump and pick-up strainer and three securing nuts. Two pump body bolts must be undone, after removal of assembly from engine, to dismantle pump. Cylindrical gauze intake strainer in sump, flange bolted to suction pipe on pump body, strainer components retained by central set bolt. Normal running pressure between 30 and 80lb/in^2, engine hot.

Cooling System

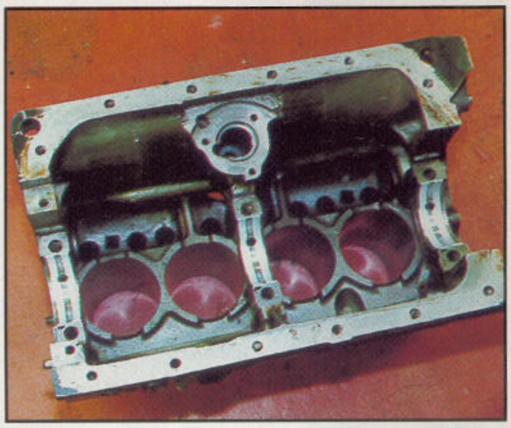
Pump and fan, thermostat located in water outlet port in cylinder head. Pump spindle has renewable seal and runs in two ball bearing races.

TRIUMPH HERALD/SPITFIRE ENGINES

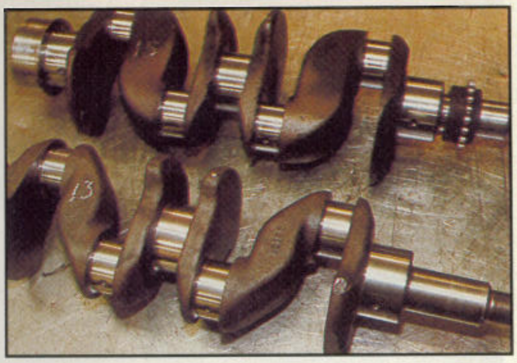
THIS is a straightforward engine to work on. Like the MGB unit, the crankcase is extended downwards in the interests of rigidity and oil retention but in this instance a detachable block is fitted over the front main bearing cap; it is sealed at its sides by wooden wedges.

Early versions of the engine used an oil-return scroll at the rear of the engine. Its housing must be carefully centralised before it is finally tightened; with the bolts lightly tightened, the housing is tapped from side to side or up and down until the clearance between it and the crankshaft scroll is even and correct all round at 0.003in for aluminium housings and 0.002in for iron ones. Where a lip seal is fitted, the seal in its housing is

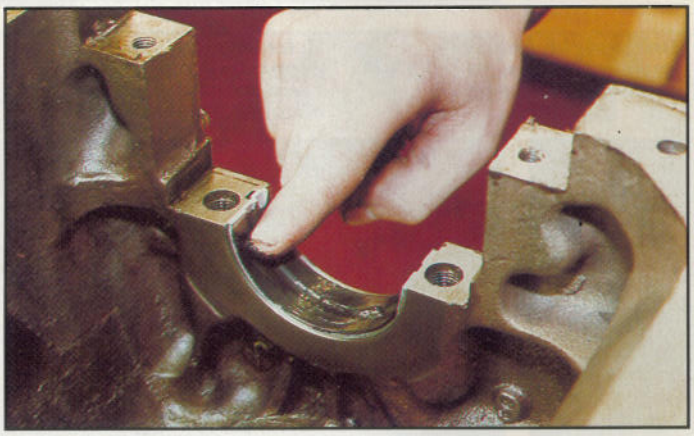
Text and pictures above relate to the rebuild of a Triumph Spitfire 1500 engine. Motor Trader service data is specific to the Triumph Herald 1,147cc engine

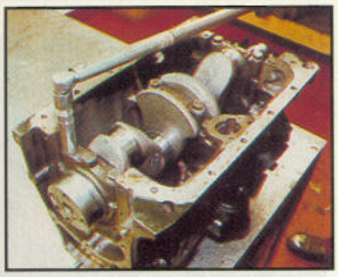


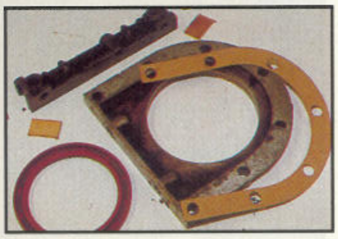
Above, empty crankcase, ready for rebuilding



Above, Spitfire four-cylinder crankshafts: 1,493cc (top), 1,296cc (bottom)
Below, Spitfire main bearing caps being torqued down to 55-60lb/ft







Above, Spitfire's rear crankshaft seal track must be lubricated generously. Right, sealing block and packing (front) and rear seal housing and gasket

TRIUMPH HERALD 1,147cc *MOTOR TRADER* SERVICE DATA

Mounting

At front, bonded rubber blocks bolted up to feet on front engine plate and to extensions on chassis frame. At rear, cylindrical rubber blocks bolted up to either side of gearbox extension casing and to cradle which is centre-bolted to chassis frame. Tighten all nuts and bolts fully.

Removal

Engine may be removed with or without gearbox. To remove with gearbox: remove bonnet by taking out each hinge bolt, disconnect battery, remove all pipes, wires and flexible controls to engine and gearbox. Drain coolant after removal of radiator cap. Take off top and bottom water hoses, remove radiator matrix held by bolts either side. Disconnect exhaust pipe at flange joint and at clip on clutch housing. Attach sling of lifting tackle to eye on front of dynamo adjusting link and eye at rear of cylinder head. Remove gearbox cover, 11 self-tapping screws – three accessible from behind engine. Undo front mounting nuts and rear mounting bracket nuts, when mounting rubbers will remain *in situ*. Disconnect propeller shaft at gearbox flange joint, remove clutch slave cylinder mounting pinch bolt. Arrange sling so that unit will assume a suitable angle and lift engine/gearbox up and out of vehicle.

Engine may be removed without gearbox after removal of bellhousing bolts and starter mounting bolts, with care being taken to see that gearbox is supported while engine is drawn forward to clear primary shaft splines and flywheel spigot. Replacement is reversal of above process.

PISTONS AND RINGS		
Clearance (skirt)		0.0012-0.0019in
Oversizes		0.010, 0.020, 0.030
Weight without rings or pin		9 oz 8 dr ± 3 dr
Gudgeon pin: diameter		0.8125-0.81226in
fit in piston		light push fit at 212°F
fit in con-rod		0.0002in press fit at 68°F
	Compression	Oil Control
No. of rings	2	1
Gap	0.008-0.013in	0.008-0.013in
Side clearance in grooves	0.003-0.010in	0.0007-0.0027in
Width of rings	0.0787-0.0777in	0.1553-0.1563in

NUT TIGHTENING TORQUE DATA	Bolt size (in)	lb-ft
ENGINE		
Main bearing caps	7/16	55-60
Cylinder head studs	3/8	38-42
Flywheel	3/8	42-46
Con-rod bolts	3/8	42-46

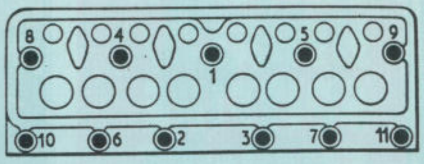
Crankshaft

Three main bearings. Steel backed white-metal-lined shells located by tabs in block and caps. No hand-fitting permissible. Shells may be removed and replaced with engine in position, but only in emergency. End float controlled by split thrust washers fitted either side of rear main bearing. Oversize sets of washers available.

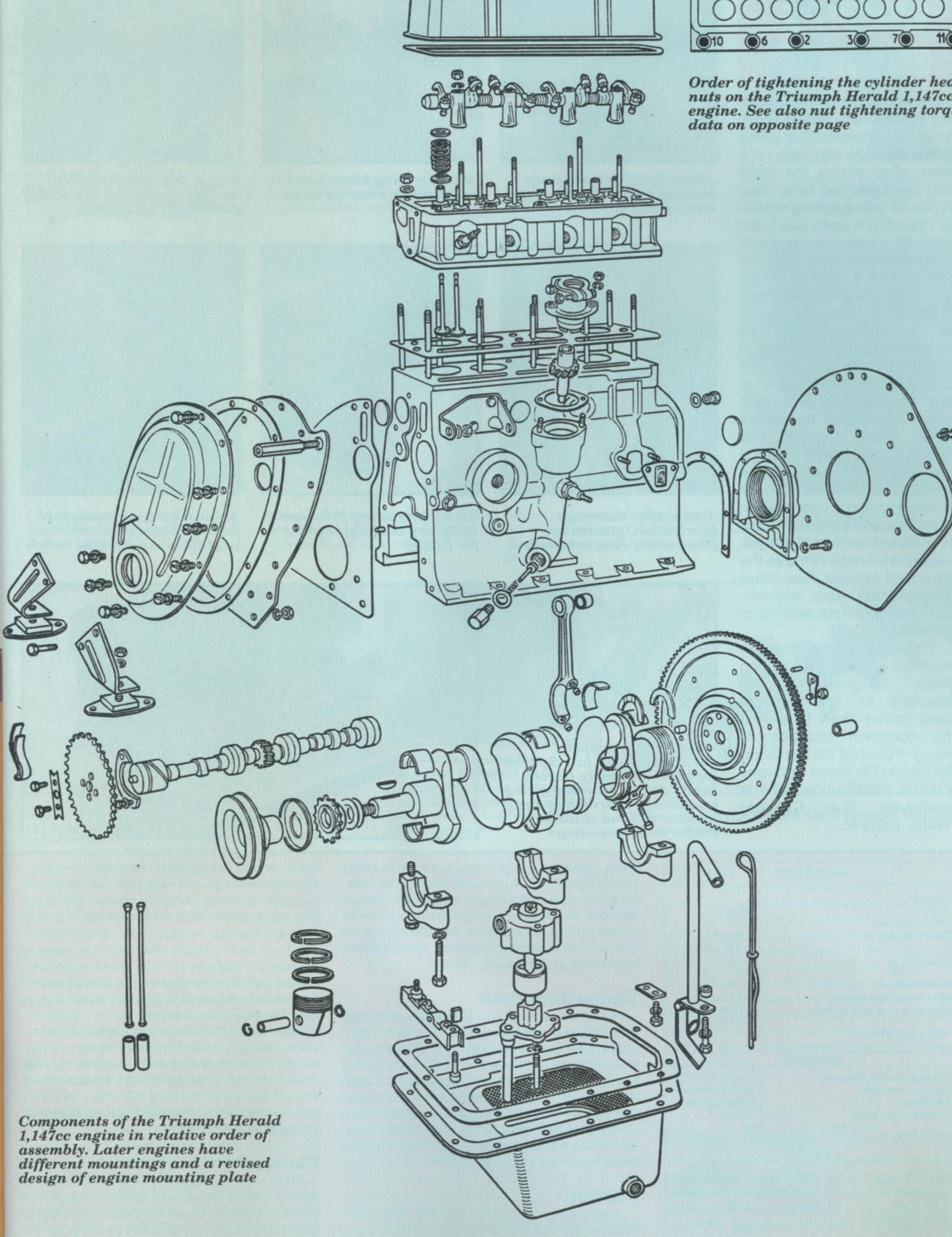
Flywheel fitted with shrunk-on ring gear, spigoted on rear flange of crankshaft and retained by four 3/8in bolts and located by one dowel. Oilite spigot bush pressed into crankshaft boss. Camshaft drive sprocket and fan pulley keyed to front end of shaft with long Woodruff key and retained by starter dog nut and lock washer. Dished oil thrower fitted between camshaft sprocket and timing cover. Hub of fan pulley passes through lipped renewable oil seal pressed into timing cover.

Sealing strip fitted to front end of cylinder block, rear oil seal, retained on rear face of block by seven setscrews. When fitting front

CRANKSHAFT AND CON-RODS			
	Main Bearings		Crankpins
Diameter	2.001-2.0005in		1.625-1.6255in
	Front & Inter	Rear	
Length (in)	0.995-1.005	1.2995-1.2975	0.9085-0.9086in
Running clearance: main bearings			0.0005-0.0032in
big ends			0.0005-0.002in
End float: main bearings			0.004-0.011in
big ends			0.008-0.011in
Undersizes			0.010, 0.020, 0.030
Con-rod centres			0.040in
No of teeth on starter ring gear/pinion			117/9



Order of tightening the cylinder head nuts on the Triumph Herald 1,147cc engine. See also nut tightening torque data on opposite page

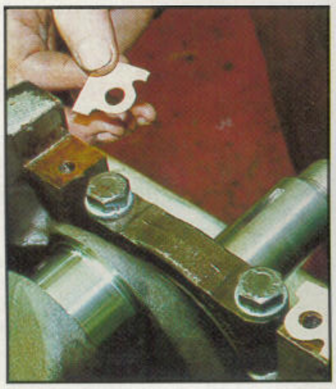


Components of the Triumph Herald 1,147cc engine in relative order of assembly. Later engines have different mountings and a revised design of engine mounting plate

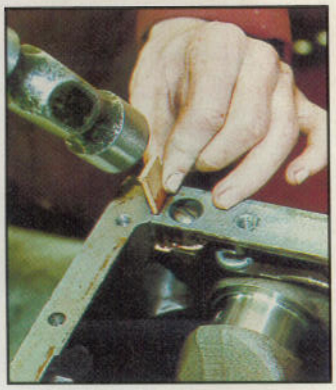
TRIUMPH HERALD/ SPITFIRE ENGINES

oiled before assembly. With the screws *very lightly* tightened the crankshaft is given a few turns to centralise the seal, after which the bolts can be tightened fully. Two types of valve-spring retainer caps have been used, the first of these has a small counterbored hole at the centre and a slightly larger one offset to one side; these holes break into one another. On engines using this arrangement, valve removal is effected by pushing the cap down slightly and sliding it across to bring the valve stem into the larger hole, when the cap and spring(s) will come away. If you are doing this without using tools, a block of wood shaped to fit the combustion chamber and screwed to the workbench will hold up the valves while you remove the caps and springs. The other arrangement uses conventional split collets seating in the retainer cap.

The water pump arrangement is a little unusual on these engines, being attached to the cylinder head rather than following the common practice of being mounted on the cylinder block. On some versions a water distribution tube is employed. (See Cylinder Heads, page 6).



Above, Spitfire front main bearing cap and gaskets for sealing block



Above, sealing block fitted and wooden packing being tapped in

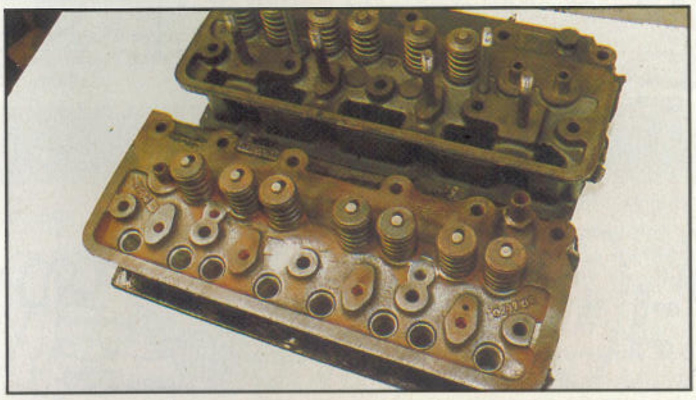
Above, rear crankshaft oil seal track must be lubricated generously with grease

Above, after thorough lubrication, pistons are fitted using ring compressor

Above, preparing Triumph Spitfire front engine plate for fitting

Above, Spitfire camshaft is fed into place with the engine inverted on the bench

Above, fitting tappets/ followers. Right, late Spitfire (bottom) and early Herald heads. Different valve spring retention, pushrod housings, number of head studs and rockershaft mountings



TRIUMPH HERALD 1,147cc

ENGINE DATA	
General	
Type	OHV
No of cylinders	4
Bore x stroke: mm	69.3 x 76
in	2.728 x 2.992
Capacity: cc	1,147
in^3	70
RAC rated hp	11.9
Max bhp at rpm (gross)	43 at 4,500
Max torque at rpm (gross)	775 lb-in at 2,250
Compression ratio	8:1

CAMSHAFT	
Bearing journal: diameter	1.8402-1.8407in
Bearing clearance	0.0026-0.0046in
End-float	0.008-0.004in
Timing chain: pitch	0.375in
No of links	62

VALVES	Inlet	Exhaust
Head diameter	1.305-1.304in	1.152-1.148in
Stem diameter	0.311-0.310in	0.309-0.308in
Face-angle	45°	45°
Spring length:		
fitted	1.35in	
at load	27-30lb	

front sealing strips, tap in wooden filler pieces and trim flush with crankcase face. Rear oil seal (aluminium alloy) has thread scrolled in inner diameter for oil return to sump and there must be 0.003in clearance between scroll and crankshaft. Composition seal fitted around sump flange.

Connecting Rods

H-section stamping. Big ends thin-wall steel-backed whitemetal-lined shells located by tabs in rod and cap. No provision for hand-fitting, con-rod split diagonally for removal through bores and cap dowel located on rod. Clevite split small end bush pressed in. Fully floating gudgeon pin located by circlips in piston. Fit with short shoulder of big-end to the camshaft side. Tighten bolts to torque figure specified.

Pistons

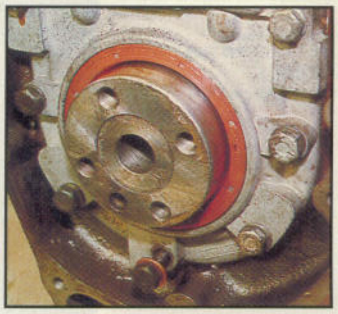
Aluminium alloy, flat topped split skirt. Pistons graded into three sizes of standard dimensions: F, G and H, identified by one of these letters stamped on the piston crown. Grades of piston are matched with grade of cylinder bore by selective assembly. Bore size increased in 0.0004in steps on F, G and H size markings respectively. Identification mark of bore grade stamped on casting adjacent to bore in cylinder block.

Two parallel-faced compression rings and one slotted oil-control ring are fitted above fully floating gudgeon pin.

Remove rod and piston assembly complete through bore; fit with split skirt of piston to non thrust (camshaft) side of engine. When renewing gudgeon pin bushes, they should be broached to 0.938-0.937in. Fit of pin is selective and should be tight push-fit at room temperature.

Camshaft

Single row endless roller chain drive with spring tensioner. Shaft runs in machined bores in cylinder block casting. End-thrust is taken and location is effected by a C-plate fitted to front engine bearer plate, and

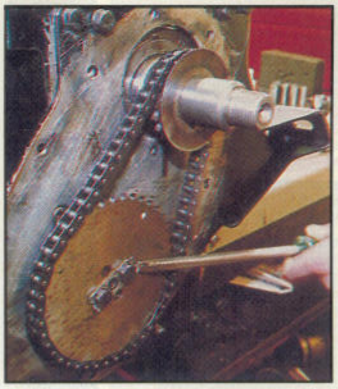


Above, seal and housing are centralised by turning crankshaft a few times with seal-housing nuts very lightly nipped. Do not omit copper washer on top bolt (engine shown inverted)

Above, Spitfire piston and connecting rod assembly with big-end caps on right

Above, Spitfire pistons may need warming to fit fully-floating gudgeon pins

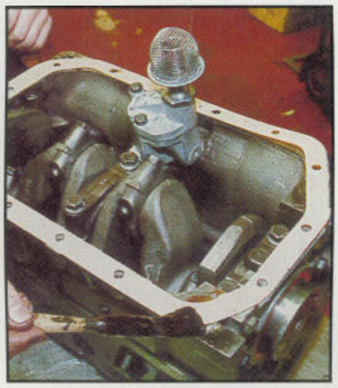
Above, gudgeon pins are secured in the piston by Seeger circlips



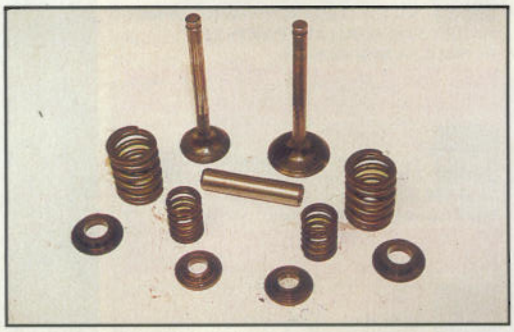
Above, the timing drive is assembled, aligning timing marks (engine inverted)

Above, this spring tensioner keeps timing chain adjusted; lubricate on assembly

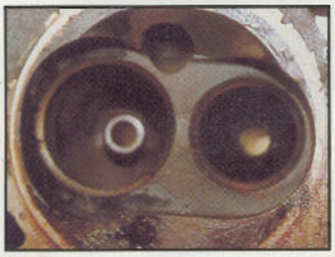
Above, scrutinise oil pump for rough edges. Check clearances with rotors fitted in body



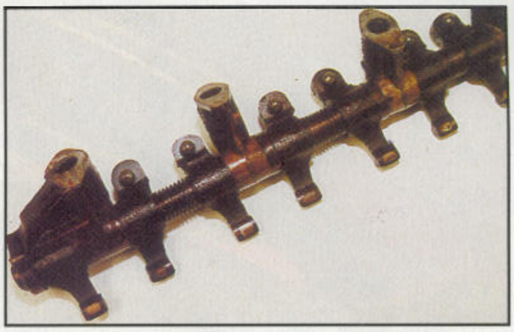
Above, if in doubt, replace the oil pump. The sump may be fitted at this stage



Above, Triumph Spitfire valves, exhaust on the left and larger inlet on the right



Spitfire combustion chamber. Exhaust valve seating (right) is pitted and must be refaced or an insert fitted. Inlet should be OK after lapping



Above, rockershaft from the Triumph Spitfire 1,493cc engine

retained by two setscrews. Driven wheel retained by two setbolts on camshaft end boss. Provision made for adjustment of chain wheel to give ¼ tooth variations in valve timing.

Valves

Overhead, non-interchangeable, inlet larger than exhaust. Springs secured by eccentric collar retainers. Fit springs with close coils to cylinder head. Valve guides plain, no shoulder, press in from top until guide projects ¾in from top of cylinder head. Inserts shrunk in when required.

Tappets and Rockers

Plain barrel tappets sliding directly in crankcase. Tappets may be removed with long-nosed pliers after removal of cylinder head. Rockers are offset left- and right-handed in pairs, drilled for lubrication and run direct on hollow shaft. Each pair operates either side of rocker post and intermediary rockers are separated by long coil springs. Oil fed from gallery is metered by grooved camshaft rear bearing and delivered via head drillings to rear rocker pedestal and thence to shaft and individual rockers. Tappet clearance must be set to 0.040in for timing and to 0.010in (cold) for normal running.

Lubrication

Hobourn-Eaton eccentric double rotor type pump, spigoted and flange bolted in sump. Centre rotor driven by shaft pressed into rotor and pegged in position. Upper end of rotor driveshaft engages with tongue on distributor shaft. Three long bolts attach pump body to cylinder block. Pump may be removed with engine in position. Oil pressure warning light provided on dashboard and cuts out at an oil pressure of 7lb/in^2. Normal running pressure 65-70lb/in^2. Full flow filter fitted.

Non-adjustable spring-loaded release valve housed on nearside of crankcase.

Ignition

Coil, distributor incorporates auto and centrifugal advance mechanism. Distributor drive is taken from camshaft and helical gear at upper end has an offset slot for location of dogs on distributor drive shaft. When timing after reassembly of oil pump and drive gears, correct position of distributor drive gear is obtained when smaller 'half moon' formed by slot in gear is uppermost and slot is in direct line with centre hole of oil filter boss, and engine is set for TDC no 1 cylinder firing.

Cooling System

Pump and fan. Non-adjustable bellows thermostat retained in outlet port of pump body by outlet elbow. Fan belt adjustment provided by swinging dynamo unit. Correctly adjusted belt has ¾in of play in longest run.