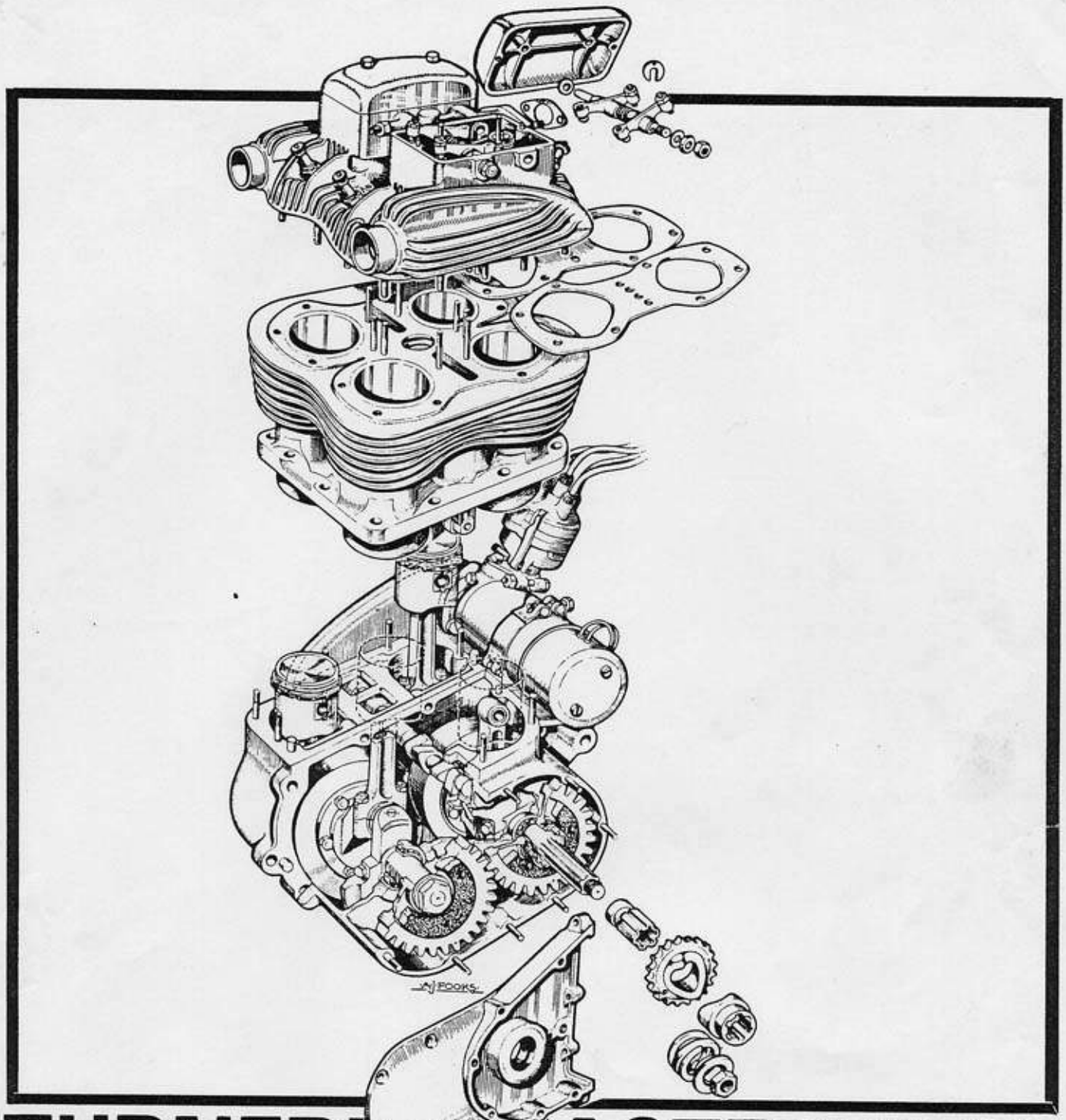


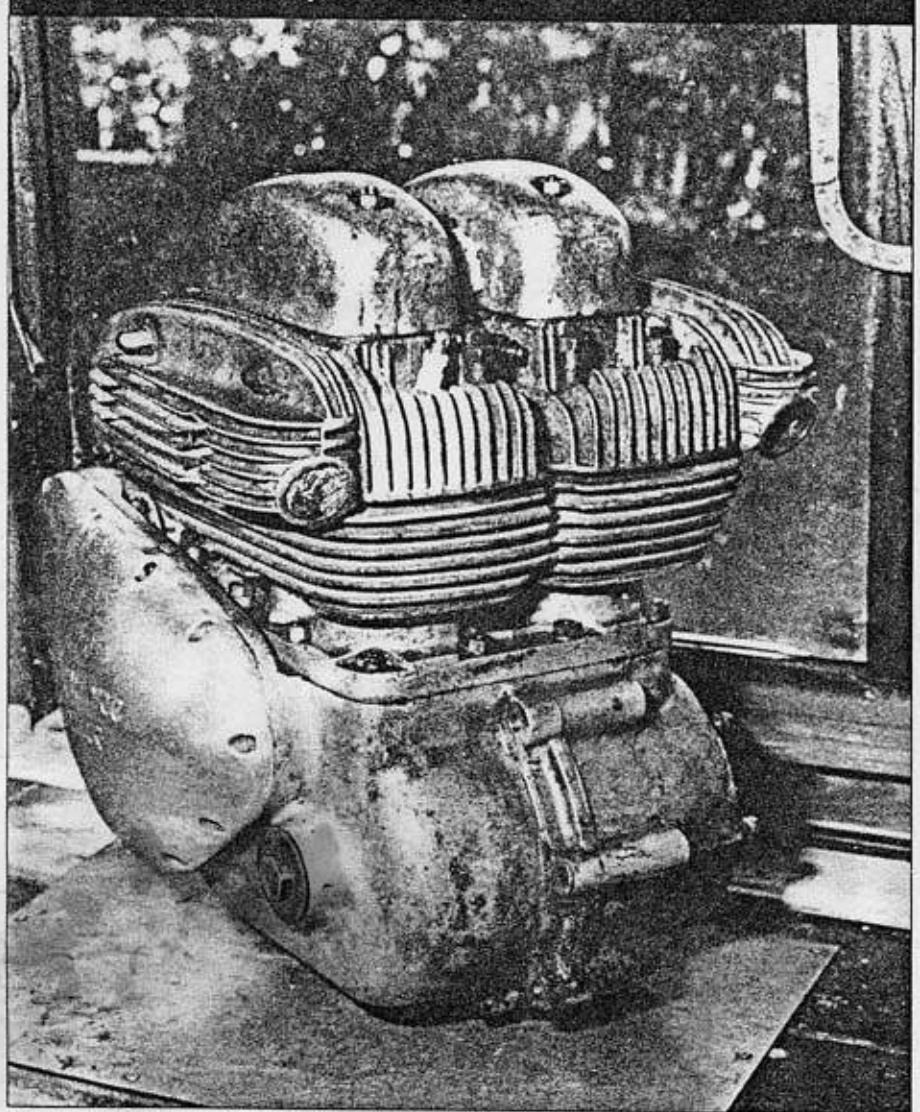
TURNER'S MASTERPIECE

- The Ariel Square Four is the only truly original engine design to go into mass production in a British factory.
- It was designed by Edward Turner, who had been taken on by Ariel in 1927, as a 500cc overhead cam sports motor.
- The prototype was shoehorned into a lightweight frame which, combined with its compact construction and three-speed gearbox in unit, made it very lively.
- Production rationalisation saw a separate four-speed gearbox and a heavyweight frame and cycle parts; the sports image was slipping.
- The 500 lasted three years, being superseded by a 600cc version in 1933 aimed at the sidecar market.
- In 1935 Edward Turner redesigned the Square Four, making it into a full 1,000 and abandoning the overhead camshaft in favour of simpler, cheaper pushrod valve actuation.
- A 600cc version was made for a short period just before the war.
- As it had developed, the Square Four engine had put on weight, and Val Page was put to work to make it lighter.
- The new unit, with crankcases and cylinder head in light alloy, went on show in 1948.
- Last of the line was the 4G Mk2, introduced in 1953; its most noticeable feature was a four-pipe exhaust system.
- All Ariel four-stroke production came to an end in August 1959.

SERVICE NOTES

THE ARIEL SQUARE FOUR

JIM LEE, Ariel marque specialist, overhauls the unique four pot motor.



Last of the line. The MkII OHV 1000cc Four manufactured from 1953 to 1958.

☐ Ariel's first 1000cc four-cylinder model was introduced for the 1937 season to replace the 600cc overhead cam model. The new engine had a cast-iron overhead-valve configuration, with 65mm bore and 75mm stroke. These dimensions were to remain the same until the model's demise in 1959.

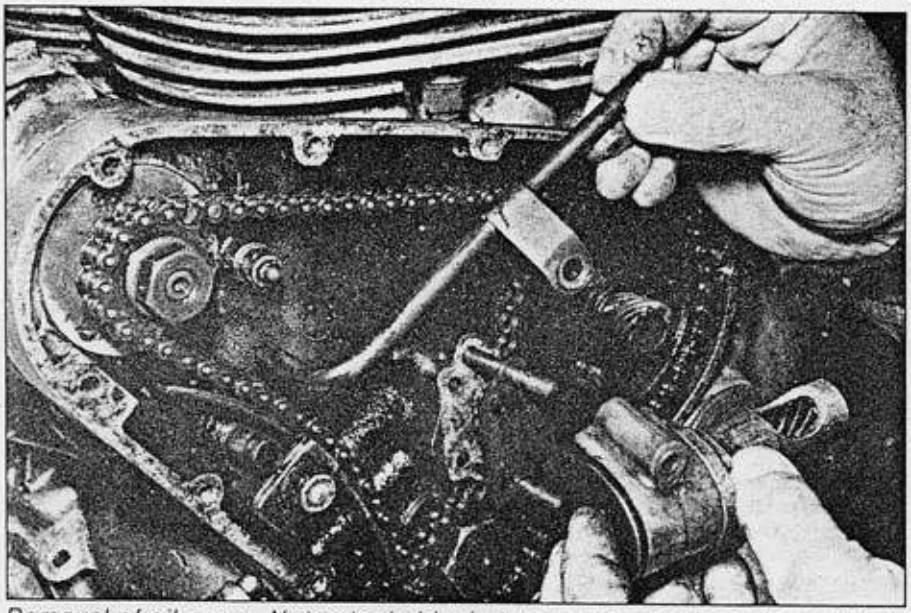
The cast-iron engine was made until early 1940, then discontinued during the war and reintroduced when the factory resumed peacetime production late in 1945. From 1945 to 1948 this model continued with the engine unchanged, but for the 1949 season the first of the alloy-engined models came in as the MkI. The crankcase layout and timing side arrangement was the same as on the iron model, except for the introduction of coil ignition with a new Lucas dynamo replacing the old Lucas Magdyno.

The MkI engine had an alloy cylinder block and all-alloy head with the exhaust manifolds integral with the head. Two exhaust pipes were used and, like the iron engine, were taken off the front of the manifold.

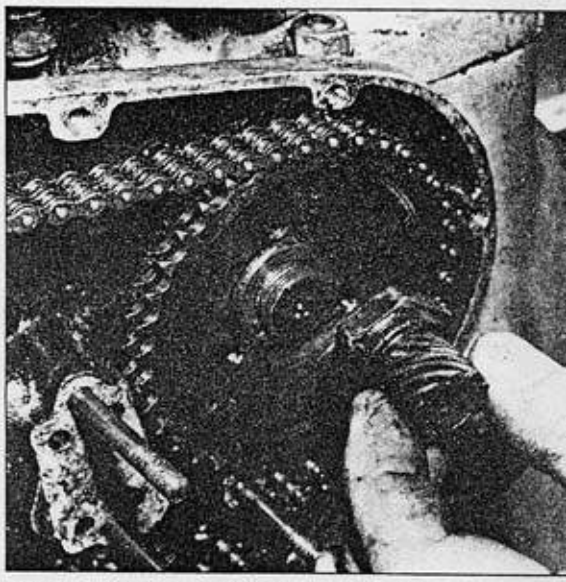
Unfortunately the MkI engine suffered from a number of design problems. Excessive heat build-up in the head was caused by the exhaust manifolds being part of the whole casting and an alloy of dubious quality being used. Although a few pence cheaper than the material specified, this was more than outweighed by the expense of warranty claims made by dissatisfied customers.

For 1953 the last of the line came in as the all-alloy MkII, and the main consideration here was to improve the reliability of the cylinder head layout. To this end the factory improved the exhaust manifold, making it detachable from the main casting, whilst providing two outlets for the pipes on each side. The rocker gear was also revamped. In this guise the Ariel Square Four continued in production until early 1959 when the whole range of four-stroke models was finally dropped completely.

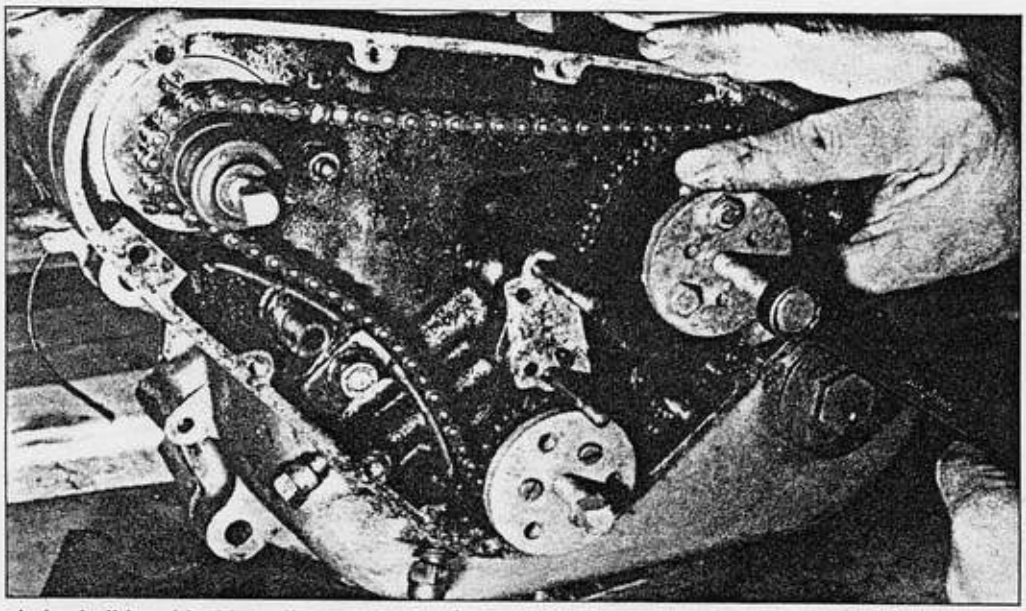
All Square Four engines are basically the same, their differences being in detail modification which will be dealt with as we go along. In my experience two main factors are to be considered when overhauling and using any of the Square Four models. First, everything must be kept scrupulously clean, with particular attention paid to the engine internals, making sure that all oilways are free of sludge and hard carbon deposits. This may sound obvious but in the crankshafts, particularly, the sludge traps are very small and efficient, and many a broken conrod has been caused by a



Removal of oil pump. Note steel shim between pump and crankcase joint. Note breather pipe.



Oil pump worm drive is a left hand thread fit on the end of the camshaft.



Late 1956 and all 1957/8 engines are fitted with the solid steel chain tensioner to allow for ⅛in lift between crankshaft and camshaft sprockets. Note three extractors to remove timing sprockets. Late 1956 and 1957/8 engines are fitted with duplex timing chain and sprockets calibrated to operate the special dynamo drive gearing which ensures an early cut-in phase on the dynamo charging circuit.

sludge build-up blocking off the oil-feed to the big ends.

It is also essential to maintain a clean lubrication system at all times, with oil changes at 1,000 mile intervals, and more often if the machine is only used for short journeys and infrequent rallying. A good quality monograde oil should be used – modern multigrades only cause disasters! – and the original grades recommended by the factory are found to give best results.

Lastly, always bear in mind that although the four-cylinder layout of the Square Four engine sounds very nice, it was not designed to be driven like a sports car! Engine bhp varied between 34 and 40 at a maximum of 5,800rpm and as a result they were not intended to be raced or rallied.

In all cases of major engine failure, I have found the causes to be sludge blocking the oilways, particularly those in the cranks, and the engine having been thrashed at peak revs. The most useful modification is the fitting of an oil-cooler and the small unit used, for example, on the Triumph/BSA three-cylinder models, lends itself readily to this application.

Stripping the unit is quite straightforward and the top end on all types can be removed down to the crankcase with the engine in the frame. This reduces the weight of what is a very heavy engine and makes final removal of the bottom end from the frame much easier. Remove the petrol tank.

After detaching the exhaust system and control cables, remove the carburettor which is held by two 5/16in fastenings to the inlet in the conventional manner. Detach the distributor cap and HT leads, labelling them as they are removed from each of the plugs.

CYLINDER HEAD REMOVAL (IRON ENGINE)

Remove the rocker oil-feed pipe and the twelve bolts securing the head, including the four extended centre bolts which pass through the rocker box. The dome nuts securing the rocker cover screw on to these extended bolts.

It is advisable to remove the rocker shafts at this stage and this can be carried out with the aid of one of the extended centre bolts which pass through the rocker box. First take out the two banjo bolts which pass through the side of the rocker box. This exposes the ends of the rocker shafts and, after slackening off the rocker adjusters, one of the extended bolts can be screwed into the end of each shaft whereupon the shaft can be pulled free. Make a note of the rocker assemblies, and the order of the various shims. The rocker arms can then be ▶

lifted out. At the same time this will facilitate removal of the push-rods which can now be removed from their respective holes. All rocker gear, shafts and shims, should be carefully labelled and kept in order of assembly.

At this stage the exhaust manifolds can be removed from each side of the head after removing the eight (four each side) ¼in nuts and chrome decorative strips. Some iron engines also had alloy exhaust manifolds fitted and care must be taken to ensure that both these and the iron type are not damaged on removal. Lift the cylinder head clear and away to one side.

Attention to the valves requires a conventional ohv spring comnpressor tool and any valve caps fitted should be removed and placed on one side with their respective valve/spring assembly.

CYLINDER HEAD REMOVAL (ALLOY MKI)

Remove the carb and oil-feed pipes as above. Note that the rocker covers can be taken off after detaching the two securing nuts on each; the rocker boxes on these models are integral with the head. Remove the eight head securing nuts from the studs which extend upwards and through the head casting. In addition, there are four nuts located inside the rocker boxes and four on the outside.

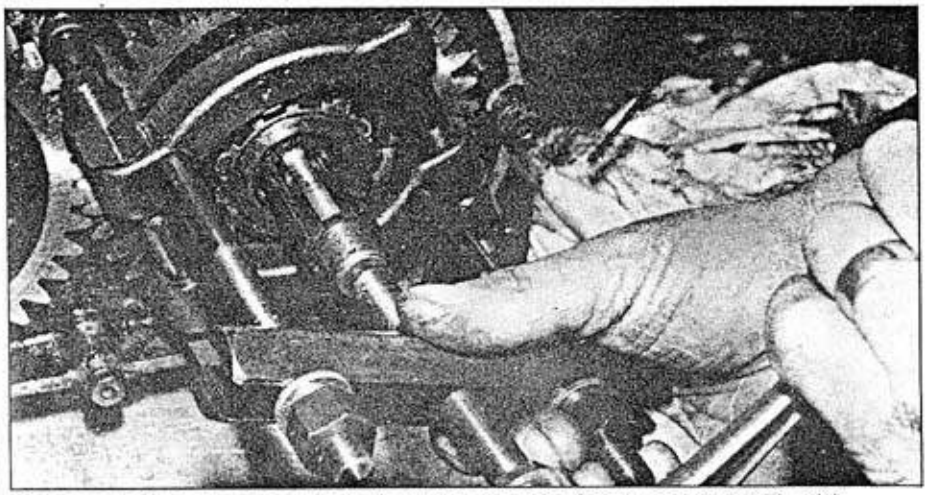
Between the second and third cylinder block fins there are twelve more nuts which are attached to bolts, or studs, passing down through the block from the cylinder head. These nuts must be unscrewed almost to the end of the threads and the head lifted so that thin strips of wood or metal can be inserted at four points. The nuts can then be finally unscrewed and taken out from between the fins.

CYLINDER HEAD REMOVAL (MKII ALLOY)

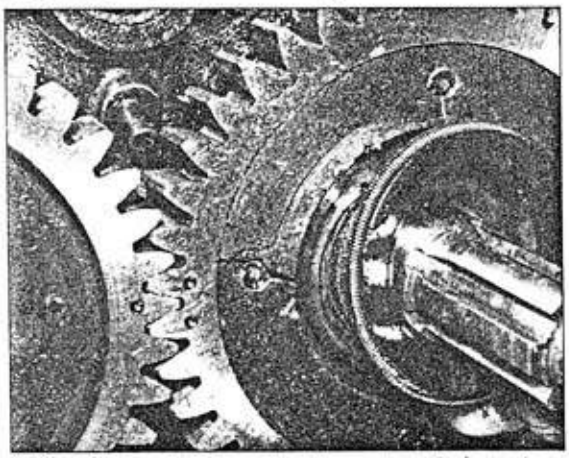
Remove all fittings as above and then take off the eight exhaust manifold dome nuts which can be lifted clear from the side of the head. If desired, the complete exhaust pipes and silencers can be left in situ and removed complete with the manifolds after detaching the exhaust system from the frame.

When Solex carburettor is fitted: unscrew the three securing nuts and retaining clamp and take out the long pillar bolt which supports the clamp. Remove eight nuts on the top outside edge of the cylinder head and the nut in the centre of the head which is visible after the induction manifold has been taken off.

When SU carburettor is fitted: the induction manifold can be removed after unscrewing the three nuts and washers.



Removal of the rear crankshaft outer bearing (part no.1432-37) with 1.124in bore. Bearings in crankcase (part no.1431-37) have 1.125in bore and must not be interchanged with 1432-37.



Teeth on crankshaft coupling gears are centre dotted for correct timing. The marking is duplicated and either combination may be used. Note rear crank oil seal, and red fibre quietening discs on coupling gears, which in this case require replacement.

This will reveal two nuts in the centre of the head which must be taken out, together with the eight securing nuts on the outside edge of the cylinder head.

Remove the four long sleeve nuts and four standard nuts which secure the rocker box assemblies, the latter can be lifted clear. Take note of the cross-over rocker oil-feed pipes – how they are located and the tiny fibre washers used.

The push-rods can now be lifted clear, labelled, and placed on one side. Four more nuts remain. These are located between the first and second lower fins of the cylinder block and after their removal the head can be lifted clear of the cylinder block.

REMOVING THE CYLINDER HEAD (ALL MODELS)

If any difficulty is experienced in removing the head, it can usually be freed by replacing the spark plugs and rotating the engine: the head will be "blown" free by the compression. Do not use screwdrivers or tyre levers to prise the head free as this can damage the fins on the cylinder block and head.

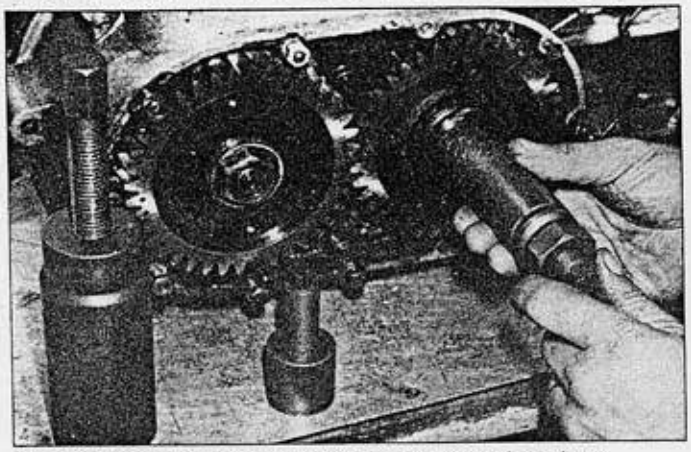
On MkI alloy models the rocker shafts can be removed by taking off the rocker spindle end nuts from the outside of the boxes and punching the spindles out using a soft drift. Note the slotted washers used to locate the spindles inside the box.

On the MkII models, make a note of the position of each rocker-block assembly, the protruding boss on each side of the box and how the spindle has its bearing surface offset. The spindle fits into the extended boss side of the steel box with the longest part of the spindle.

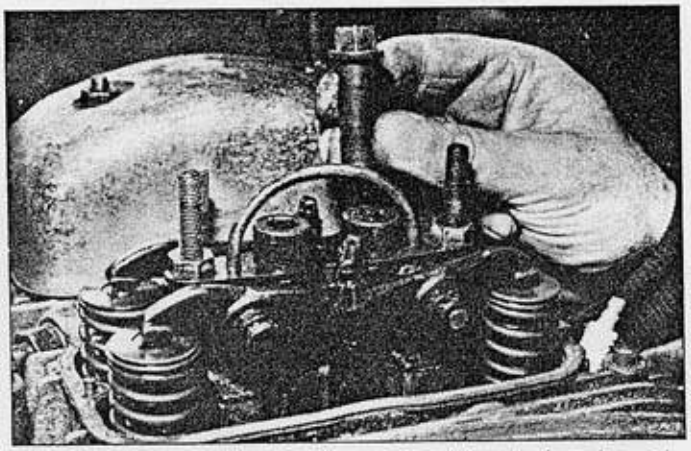
The rocker arms will slide off the spindle after removal of the small circlip located in the grooved end of each spindle. Spindles are located by a brass dowelled plug made from no.10 gauge wire and this locates the spindle by way of a groove on each side and in direct line with the block fixing holes. The rocker spindles are a press fit in their support blocks – take note of the oil-feed holes and the small sealing fibre washers or O rings used at this point where the feed pipes are located.

Some MkII engines had the rocker or tappet adjusters fitted to the valve ends of the rocker but later engines had the adjusters fitted to the push-rod end of the rocker arms.

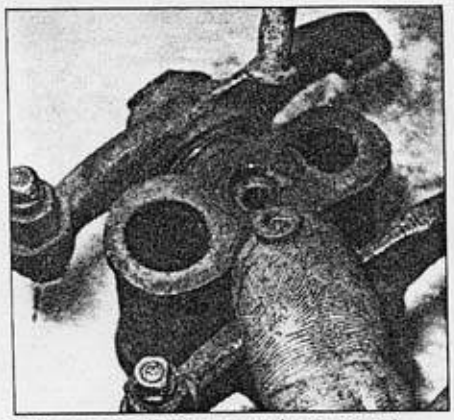
On the alloy models the valve seats are formed from a high expansion steel insert which is a press fit in the combustion chamber. No valve caps are fitted on alloy models, the valves having



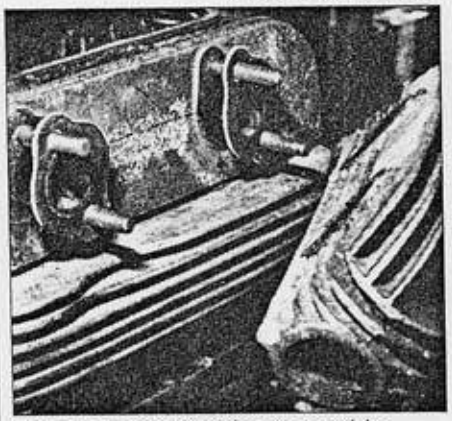
Special tools are required to remove and replace coupling gears. Front gear nut is a normal right hand thread.



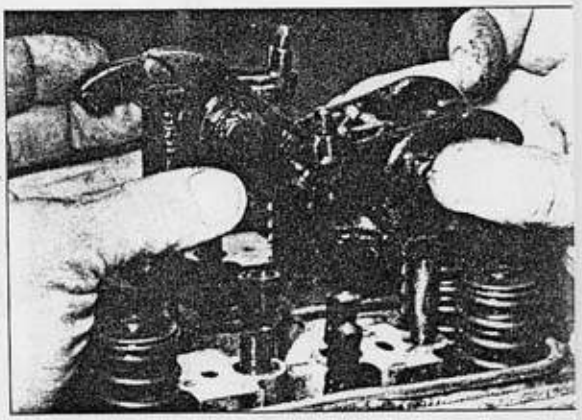
Sleeve bolts securing rocker assemblies to head must be removed carefully to avoid damage to oil feed cross-over pipe.



These small fibre washers must be fitted in recess in rocker pivot block to ensure oil tight joint for rocker spindle oil feed pipe.



Exhaust manifold is removable after undoing four chrome dome nuts. Two copper/asbestos washers are fitted at each side.



Rocker assemblies will slide off the remaining set stud, after removal of two sleeve nuts beneath cross-over oil pipe.

hardened stem ends. Hardened valve caps on the iron-engined models must be renewed if dimpled or otherwise worn.

VALVES AND VALVE SEATS

Each valve should be reground to its respective seating and not interchanged. All inlet valves have their stems undercut below the head. Grinding-in is carried out in the usual way and no special tools are required. Valve seat angle is 45° on all models.

ROCKER BOX REMOVAL (1937 TO 1948 IRON MODELS)

After considerable service these models are prone to oil leaks between the underside of the rocker box and the head joint.

With the valves and extended bolts removed, the head should be placed upside down to reveal the two nuts securing the main inlet manifold. These nuts should be removed. Remove the valve guides by using a suitable double-diameter drift. This is best carried out after heating the head in an oven (extreme heat is not required) and placing it upside down on a firm flat surface before driving out the valve guides.

Replace the rocker box using the above procedure in reverse. It is important to make sure that the alloy rocker box joint face is in good condition and the use of a modern, high heat-resistant jointing compound is recommended on all joint faces, gaskets etc. Wellseal smeared on the valve guides before replacement also helps to prevent oil from leaking where the guides pass through the rocker box to head joint.

EXAMINATION OF THE HEAD FOR DAMAGE AND CLEANING BEFORE REASSEMBLY

On all Square Four models particular attention should be paid to the condition of the cylinder head. Bead-blasting the head surfaces and making good any broken fins is essential as the engines run hot and benefit from having the maximum cooling area available. On cast-iron motors, black powder coating on head and cylinder is excellent for helping to reduce engine temperature.

Warning: With alloy engine heads which have been bead-blasted, particular care must be taken to ensure no bead is left in any of the recesses of the head. It is most important to make sure the oilways, where the oil is fed to the rockers, are absolutely clean and free of any abrasive. I have seen the rocker/valve gear completely destroyed as a result of inadequate attention to the cleaning of these parts.

On the alloy models, the oilways are a maze of nooks and crannies which trap oil sludge on a grand scale. The sludge is difficult enough to remove but it also attracts glass bead like a magnet. I recommend that you thoroughly clean and degrease the alloy head and blank off all oilways before attempting to blast it clean.

CYLINDER REMOVAL

Removal of the cylinder block is straightforward once the holding down nuts have been taken off. On the iron models, it is best to remove the Magdyno first to facilitate removal of the nuts located in the cylinder flange, although a suitable spanner can be made up from a piece of hexagon bar with an open-ended spanner cut off and welded onto the bar at right angles. The top of the hexagon bar can then be turned with a wrench.

The cylinder joint to crankcase can be broken by simultaneously tapping the side of the cylinder and lifting upwards – two pairs of hands are useful here. Extreme care must be taken to prevent damage to the cylinder fins; beware also ▶

THE ARIEL SQUARE FOUR

of broken piston rings and other debris coming adrift during this operation.

PISTONS

Piston removal can be carried out after first removing the gudgeon pin circlips in the usual way; warm the pistons before tapping out the gudgeon pins. If the pistons need replacing, make sure you mark them in the correct order.

The cylinders should be rebored or liners replaced/bored if the wear exceeds 0.008in. Likewise the pistons should be renewed if the bearing surfaces at the skirt have worn to increase the clearance 0.004in from standard.

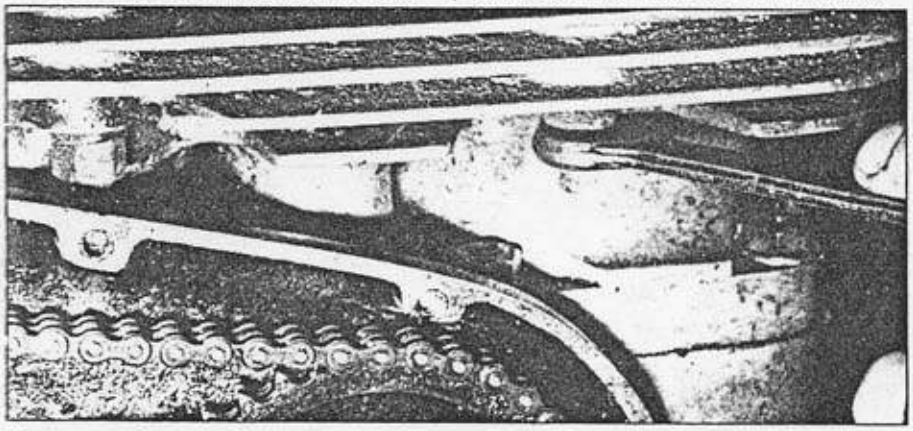
Piston rings should be renewed if the end gap has exceeded 0.030in and small end bushes should be renewed, if worn, and hand-reamed to 0.6868in – 0.6863in, or 1⅛in minus 0.001in. Later MkII engines had conrods with the gudgeon pin running direct in the eye of the rod.

Refit the top end by following the above procedure in reverse order.

STRIPPING THE COMPLETE ENGINE

Having stripped the engine down to the crankcase, the timing gears can be removed before taking the engine out of the frame, with the bottom end held secure.

After removal of the cylinder and pistons, care must be taken to ensure that the conrods are not damaged by coming into contact with the crankcase mouth. At the same time the cranks can be held secure by inserting shafts through the small end eyes of the conrods and supporting them on wooden blocks resting across the top of the crankcases.



Four nuts (two each side) must be removed before removing head.

ENGINE SHAFT SHOCK ABSORBER (1937-48)

Release the tab washer between the two lock nuts and the assembly can then be released. Note order of assembly. The assembly is not adjustable and the lock nuts should be fully tightened.

ENGINE SHAFT SHOCK ABSORBER (1949-59)

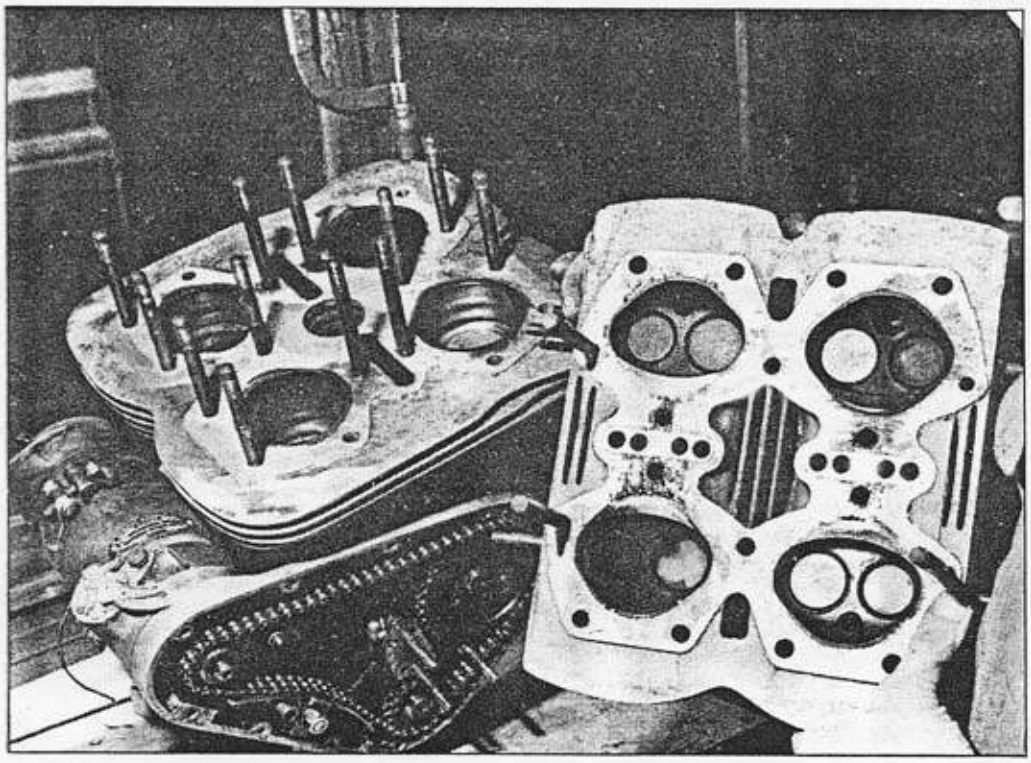
A splined sleeve and sleeve nut is used on this assembly. Note that there is an oil seal fitted next to the sprocket/coupling gear case. For the benefit of owners of earlier models this assembly is interchangeable with the previous arrangement, no alterations to the earlier shafts being necessary.

A small modification was introduced in 1952, consisting of a castellated nut and split cotter-pin fitted after drilling a no.39 hole in the threaded end of the driving shaft 1¾₄in from the end. This was to prevent any possibility of the earlier type coming undone and again is interchangeable with previous models using the MkI/MkII type shock absorber assembly.

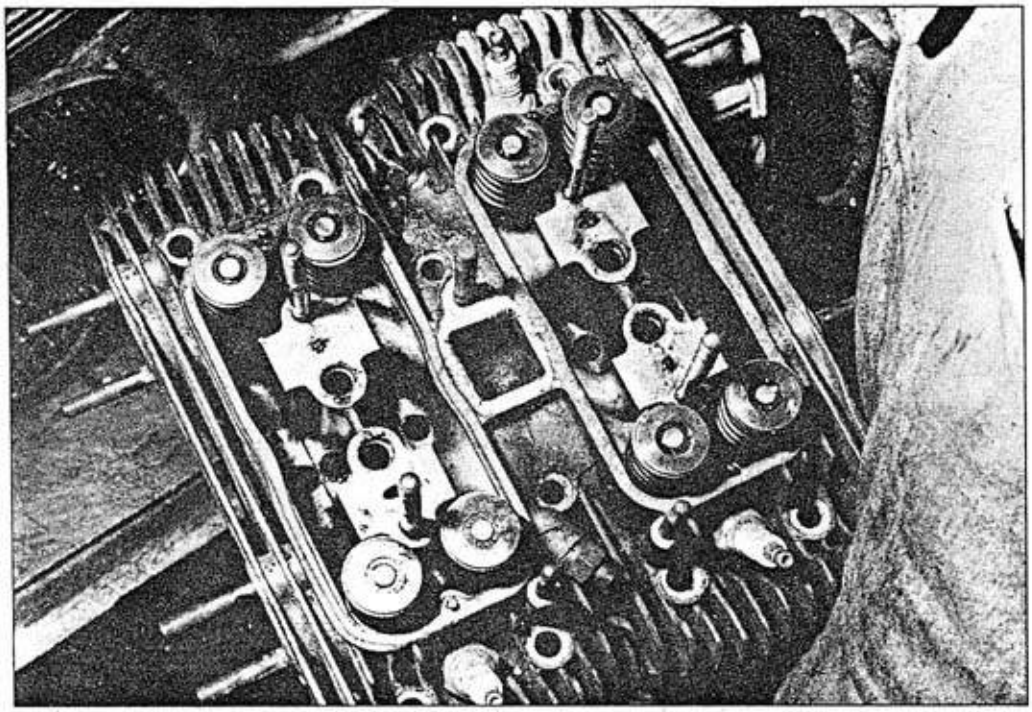
CRANKSHAFT COUPLING GEARS AND CRANKCASE BEARING OIL SEAL

On early models, oil sometimes enters the coupling gear housing and is forced through the outer bearing into the primary drive case, causing leakage via the clutch housing. A special self-adjusting oil seal was introduced to overcome this problem and was made to fit between the bearing and the rear coupling gear. From 1948 this arrangement was fitted as standard.

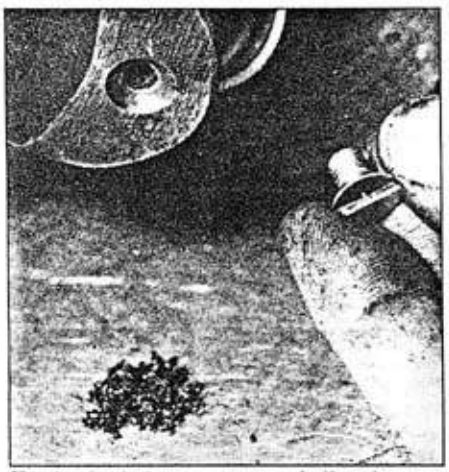
Removal of the coupling gears can be carried out either on the bench or with the engine in the frame. In either case



Great care must be taken when removing head to avoid broken fins.



No valve stem end caps are fitted on the MkII engine. Pay particular attention to oil feed to rockers, and ensure galleries in the head are cleaned out.



Typical of the amount of dirt that can be found in the crankshaft sludge traps.

the engine must be held securely whilst the operation is carried out. Remove the coupling gear cover by taking off the eleven ¼in nuts.

Note that the large roller bearing housed in the cover has an inner race which is 0.001in smaller on its centre bore than those fitted in the main crankcase. This bearing is difficult to obtain but the problem can be overcome by using one of the bearings used in the main crankcase and fitting it was the aid of Loctite bearing fit. The two bearings used in the main crankcase, along with the one used in the gear cover, should be carefully labelled if they are to be used again.

Remove the nut from the front crankshaft coupling gear. The coupling gears are now ready for extraction by means of a special set of extractor tools which also incorporate fitments for reassembling the gears on their respective

Cam followers run in alloy blocks secured to the base of the cylinder block by a locating plate, and two set bolts with lock washers.

shafts. A complete set of these tools is essential for carrying out the work properly and avoiding damage to the crankcases.

Coupling gears are a press fit on the shafts, which also incorporate steel keys. The gears are each marked with centre dots for correct meshing with the marks in pairs so that either pair of marks can be used on reassembly, providing the single marked gear meshes between the two marks on the opposite gear.

When fitting the gears, make sure that they register correctly with the keys in the respective keyways otherwise incorrect alignment will result. Before replacing the coupling gears examine the fibre discs riveted to the face of each gear. These are fitted to reduce the noise of the gears or to damp out the ringing of the gears as they revolve in use. If the fibre discs have deteriorated or become loose on the rivets, they should be renewed.

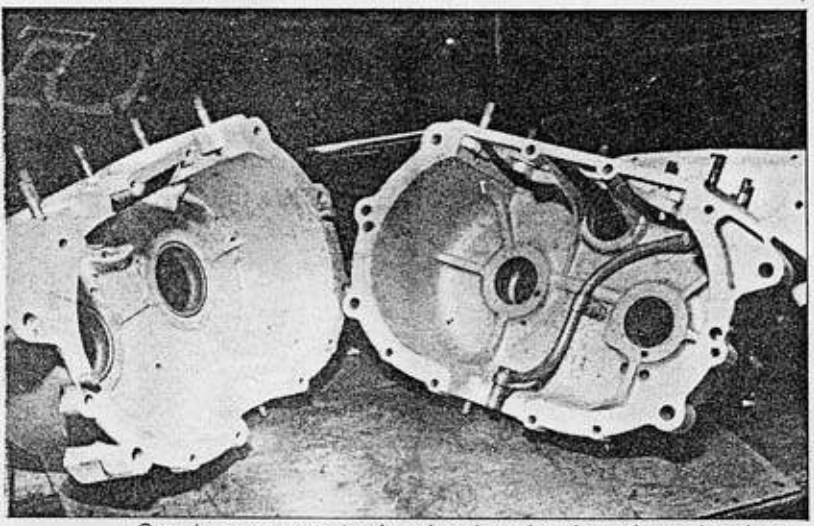
TIMING GEAR (1937-48)

Iron-engined models, and the first alloy MkI model, have a double-plunger pump driven by a small spindle extension formed on the camshaft gear nut. Remove this by taking off the two hexagon nuts and lock washers and then pulling the pump off the fixed studs. Examine the pump joint face for damage and remove the plugs in the base of the pump to expose the two springs and two balls.

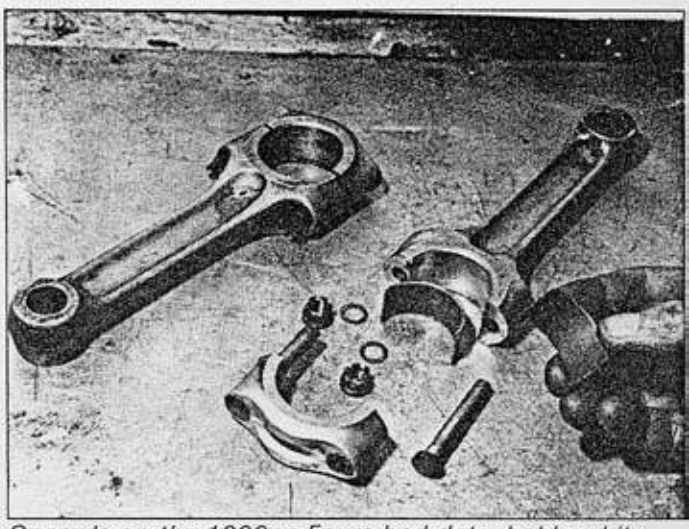
Thoroughly wash out the pump and its fittings in clean petrol and examine the plungers for any wear or scoring. Oil the components before reassembly and make sure that the balls are making correct contact in the base of the pump body. Lightly tapping the balls on to their bases using a short steel bar has the effect of keeping the seating contours accurate and well sealing.

Slightly stretching the springs will increase their tension, but this should not be overdone. Always use a new pump gasket on the joint face. The duralumin sliding block operating the plungers must be perfectly free in the guides, but not have any excess wear or up-and-down clearance.

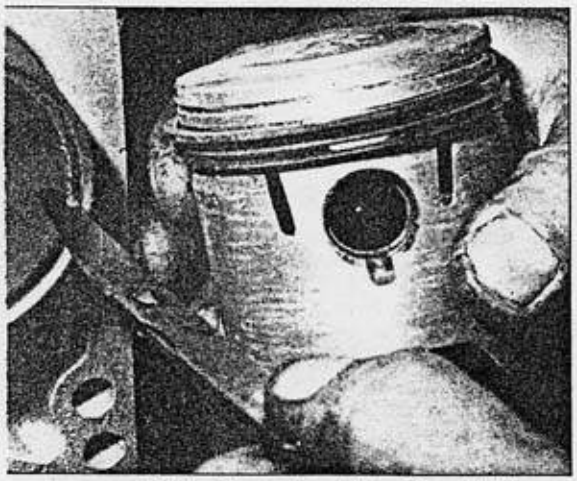
Having removed the pump, the timing gears, consisting of magneto, camshaft and crankshaft sprockets, can be withdrawn. The steel tensioner blade can be held down to reduce tension on the chain, whilst the sprockets are removed. The camshaft sprocket nut is a left hand thread and the magneto sprocket is a centre taper fit. Both the camshaft and ▶



Crankcases apart, showing bearing housings, bushes on the timing side and rollers on the drive side. Pipe secured to timing side returns oil from the sump filter.



Conrods on the 1000cc Fours had detachable white metal shells, with the rods secured by slotted type nuts and split pins which were later superseded by Simmonds pinnacle lock nuts. Note late type MkII motors had the gudgeon pin running direct in the small end eye.



MkII pistons had the "Top Hat" shaped crown, peculiar to this model.

THE ARIEL SQUARE FOUR

crankshaft sprockets are a keyed parallel fit.

A steel oil seal washer is fitted behind the rear crankshaft sprocket and front nut. Note that the camshaft sprocket is fitted with the raised centre boss inwards.

The magneto can be removed from its platform by taking off the top securing strap and removing the fixing bolt underneath. Note the position of the special joint washer between the crankcase and the magneto end cover.

TIMING GEAR MKI-II (1949-56)

From the introduction of the alloy-engined models the sparks were provided by a Lucas dynamo providing coil ignition and driven by a different type of sprocket to that used on the iron models with Magdyno.

On MkI/MkII models a new type of timing chain tensioner was introduced. This was adjustable, unlike the previous Weller type tensioner, and the fibre rubbing strip fitted along the inside top edge of the timing chest on iron models was no longer used.

Crankshaft and dynamo sprockets are removed with a special extractor or claw type puller. The nut on the camshaft and oil pump drive is a left hand thread, with the sprocket keyed to the shaft, and a tight push fit. No extractor is required to remove the camshaft sprocket which can be eased off using light leverage.

On 1937-48 models the oil pump drive should have a maximum clearance of 0.005in only between the rear face of the dural sliding block which drives the pump and the front face of the camshaft nut. Excess clearance at this point causes a tapping noise when the engine is running. To remedy this, fit shims between the camshaft sprocket and the securing nut until the correct clearance is obtained. The dynamo and distributor unit can be removed as one after removing the securing nut.

TIMING GEAR (1957-59)

The MkII Square Four became increasingly popular with police forces in Australia and New Zealand and this led to the dynamo output being stepped up to cope with the extra demand from radio equipment, and so on. This resulted in engines being fitted with duplex timing chains and sprockets calibrated to operate the dynamo drive so that the cut-in phase was earlier.

Duplex sprockets were fitted which are secured to the shafts using standard key practice and these can be withdrawn using an extractor with bolts which screw into the gear. A special screw-on type extractor is available for the dynamo sprocket.

The oil pump on the MkII models is the double-gear type driven by a worm off the camshaft. To remove the pump, take off the three nuts and slide the pump away complete with the spiral driven gear.

THE LUBRICATION SYSTEMS

Cleanliness is essential and ideally the oil should be changed every 1,000 miles. At the same time oil tanks and crankcase sump filters should be checked and cleaned. Any good monograde oil is suitable: for summer use an SAE 50 oil is recommended, and in winter an SAE 40.

On those models fitted with an oil gauge, the oil pressure should record approximately 25-35 lb/sqin, although a much higher pressure is permissible, which indicates the pump is functioning at maximum capacity and that the pressure release valve is in good working order.

On pre 1953 models the oil pressure is controlled by a spring-loaded release valve which operates as the pump produces a certain pressure limit. This valve is located in the end of the front crankshaft on the timing side and is accessible after removing the large hexagon alloy cap nut on the side of the crankcase.

The valve consists of a spring-loaded ball, secured by a split pin. It should be checked to ensure it is clean and that the ball is seating correctly. Any dirt trapped between the ball and its seat will cause the oil pressure to drop and the gauge will record little or no pressure.

On engines that have seen a lot of service or have been subject to infrequent oil changes the use of modern detergent monograde oils will cause dirt, or the by-products of combustion, to dislodge and circulate in the oil. Again, cleanliness is essential and it is always advisable to clean the system thoroughly before putting the engine back into service. Persistent problems with dirt in the pressure release valve can be traced to a

dirty engine!

On the MkII engine the pressure release valve is located in the body of the oil pump, and this should be removed and cleaned in the usual way. Lack of oil pressure can also be traced to a weak release valve spring: this can be cured by lightly stretching the spring but if this fails, the spring must be renewed. If the ball itself is damaged or appears to be no longer in perfect condition, it too should be replaced.

SPLITTING THE CRANKCASES

With the top end removed, coupling gears detached, and the timing gears and oil pump dismantled, the crankcases are ready for parting. First take off the cap nut which covers the front crankshaft and remove the nut and oil pressure valve (1937-52 models) from the end of the shaft. Remove the two bolts which secure the crankcases in the middle, along with the bolts securing the halves; the cases can now be tapped apart with a soft hammer and the crankshafts and camshaft withdrawn.

Timing-side plain bearings should be examined and if the clearance exceeds 0.004-0.005in the plain bearing bushes should be replaced. To remove the bushes, the crankcase half should be gently warmed, the grub screws removed and the bushes pressed out using a suitable mandrel or press tool.

Replacement bushes must be bored to give a finished clearance of 0.001-0.005in after they have been refitted to the crankcase. Care must be taken to ensure that the oilways are in line with the corresponding oil holes in the crankcase. Except for the pre 1949 engines, which are not fitted with pins or grub screws to secure the timing side main bushes, when new bushes are fitted they require drilling 1/16in x 1/8in deep to receive the locating grub screw. Be careful not to drill the locating hole beyond 1/8in otherwise the drill may break through into the white metal lining.

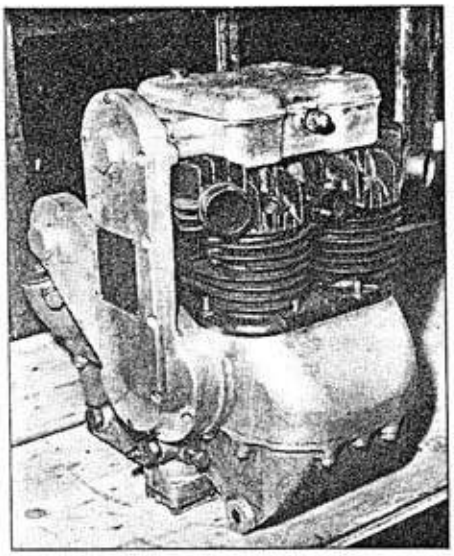
The roller bearings in the drive side crankcase half have their outer races secured by circlips. These should be removed after heating the crankcase half and, having removed the circlip, the outer race should drop out. The lipped side of the outer race is located next to the circlip groove.

CAMSHAFT BEARINGS

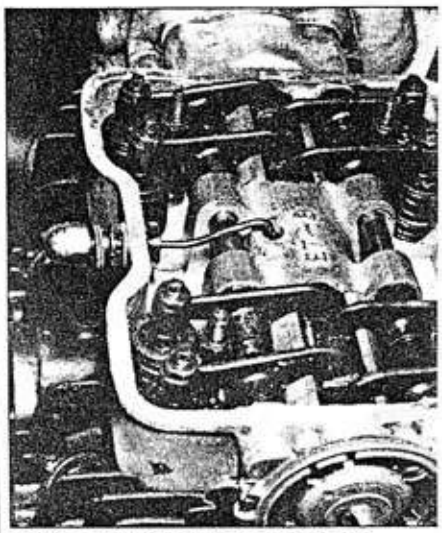
The camshaft bush should be examined for wear and replaced if necessary by gently warming the crankcase half, when the bush can be pulled out of its housing by inserting a tight fitting reamer. Turning the reamer will then enable the bush to be pulled free. New bushes must be line reamed to 0.874-0.875in after fitting, and drilled to correspond with the oil hole in the housing.

TAPPET GUIDES

These normally give very long service and it is usually sufficient to ensure that they are a correct fit in the block. If the cylinder block is to be bead blast cleaned, it is best to remove the tappet guides to prevent bead from being left in the engine by lodging around the guide block. The guides are removed by taking off the securing plates, which should be perfectly flat, and pulling free.



First of the line. The 1931 500cc OHC Square Four engine.



500cc OHC Four showing the overhead cam and rocker layout with distributor driven off the end of the camshaft.

Lucas model C355D generato with distributor drive.

CONRODS

During 1948 the connecting rods were modified to accept loose shell linings of the now common white metal type. If clearance between the big end crankshaft journal and the rod shell linings exceeds 0.003-0.004in, then the shells should be renewed. If the crankshaft itself is worn, it should be reground and new conrod shell bearings fitted. It is advisable to renew the big end connecting rod bolts after lengthy service.

CRANKSHAFTS

Particular attention should be paid to the cleaning of the sludge traps in the crankshafts! At the end of each crankshaft located in the bob-weight there are countersunk 1/4in set screws which act as blanks; behind these are the sludge traps. Due to the fact that the drilling through the crankshaft is rather small, sludge is thrown into this area and can build up to such an extent that it will block off the feed hole through the journal to the big end shells.

The set screws are secured by centre punching and it is most important to remove them and clean out the hole right through the crank. With the screws removed, the dirt will be found to be tightly packed and it will require prising free with a sharp pointed drill or piece o stiff wire. The hole should then be cleaned out thoroughly with clean petrol and blown out with an airline until absolutely clean. New set screws can be fitted and made secure by centre punching. Be sure to fit screws of the original length.

REASSEMBLY

Reassembling the engine is a straightforward reversal of the dismantling procedures.

Valve timing is generally correct wher the two holes in the camshaft sprocket are pointing downwards and in line with the timing mark on the crankshaft sprocket with no.1 piston on top dead centre. However, if any variation results the following method should be used.

Using a thin steel rule or gauge in the plug hole of no.1 cylinder, set the piston at 1/16in before TDC. With the piston in this position the camshaft should be turned until the inlet valve just commences to open. It is best to set the valve clearance at 0.002in when adoptin this method. Having obtained the correct setting of no.1 inlet valve, the crankshaft sprocket should be offered up on one of the three keyways provided and the timing chain tested for correct meshing.

This method may require all three key positions being tried before the chain locates without riding the sprockets. Once the valve timing is set correctly on no.1 cylinder, the timing will be correct

for the other cylinders.

MAGNETO TIMING (1937-48)

With the Magdyno bolted into position, no.1 piston (right hand, front) should be set 5/16in before TDC with both valves closed. The ignition advance/retard control should be in the fully advanced position and the contact breaker points just opening. The magneto drive sprocket should now be tapped on to its taper and the nut tightened. Make sure that tightening the sprocket nut does not upset the timing.

The distributor can now be set. On the rotor blade there is a line which should correspond with the line on the base plate of the distributor cover when all the back lash has been taken up by turning the rotor by hand anti-clockwise. The position of the rotor can be altered by removing the small centre screw fixing screw, prising the centre steel adaptor off and resetting it in the desired position.

The dynamo gear drives the distributor spiral gears, so if the dynamo is removed care must be taken to ensure that the engine is not turned, otherwise the magneto rotor timing will be upset.

In the end of the Magdyno there is a special greaser for lubricating the distributor spiral gears and this should be kept full of clean grease at all times. Turning the grease cap will force small amounts of grease into the gears.

TIMING THE DISTRIBUTOR (COIL IGNITION MODELS 1949-59)

Set the contact breaker points so that they are just opening when no.1 piston is at TDC and the automatic advance/retard control is in the retarded position. When the engine is stationary, the automatic advance/retard will normally be in the fully retarded position.

Any slight adjustment to the ignition timing can be carried out by rotating the distributor head backwards and forwards. Note the arrow marking the direction of retard, and rotating the distributor anti-clockwise or against the arrow to advance. The firing order is no.1 (front, right hand cylinder) no.2, no.3, no.4, the latter being the front left hand side.

600CC OHV SQUARE FOUR MODEL 4F 1937 AND 1939/40

During 1937, and again for the 1939 season, the factory produced a 600cc ohv version of the iron 1000cc ohv engine. These engines were identical to the larger model except that the bore size was reduced from 65mm to 50.4mm. The stroke at 75mm remained the same for both models.

All the foregoing maintenance and overhaul information applies to these models.

ENGINE PREFIX LETTERS

1937	1000cc	DC
1937	600cc	KC
1938	1000cc	DD
1939	1000cc	DE
1939	600cc	EE
1940	1000cc	DH
1940	600cc	EH

These models were carried through from the 1939 build.

1945/6/7	1000cc	DK
1948	1000cc	CJ
1949	1000cc	FJ

(first MkI alloy models).

1950	1000cc	JJ
1951	1000cc	RD
1952	1000cc	TM
1953 (MkI)	1000cc	XH
1953 (MkII)	1000cc	XJ
1954	1000cc	PL
1955	1000cc	GL
1956	1000cc	ML
1957	1000cc	NML
1958	1000cc	CNML

TECHNICAL DATA

Engine OHV Model 4F 1937 39 40
Bore 50.4mm Stroke 75mm
Capacity 599cc Comp ratio 6.9:1 bhp 23
Peak revs 5,600rpm
OHV Model 4G 1937-48 Bore 65mm Stroke 75mm
Capacity 997cc Comp ratio 5.8:1 bph 36
Peak revs 5,800rpm
OHV Model 4G 1949-53 MkI Bore 65mm Stroke 75mm
Capacity 997cc Comp ratio 6.0:1 bhp 34.5 Peak revs 5,400rpm
OHV Model 4G MkII 1953-59 Bore 65mm Stroke 75mm
Capacity 997cc Comp ratio 6.7:1 bhp 40
Peak revs 5,600rpm

Valve timing
Inlet valve opens 1/16in or 25° BTDC
Inlet valve closes 1/2in or 55° ABDC
Exhaust valve opens 11/32in or 60° BBDC
Exhaust valve closes 1/8in or 20° ATDC

Ignition timing
1937-48 5/16in BTDC fully advanced
1949-59 TDC fully retarded

Valve clearances (with engine cold)
1937-48 Inlet 0.006in Exhaust 0.008in
1949-53 MkI Inlet 0.001in Exhaust 0.001in
1953-59 MkII Inlet 0.006in Exhaust 0.008in

Piston ring gap
1937-48 0.010-0.012in
1949-59 Compression rings 0.012-0.017in Oil control rings 0.015-0.020in

Piston clearance in bore
Ring land 1937-48 0.016-0.019in
1949-59 0.020-0.023in
Below rings 1937-48 0.004-0.006in
1949-59 0.003-0.005in
Extreme skirt 1937-48 0.002-0.004in
1949-59 0.001-0.003in

Oil pressure
1937-48 (adjustable) approx 40lb/sqin
1949-59 (non-adjustable) 25-35lb/sqin

Valve seat angle
All models 45°

Gudgeon pin diameter
0.6865-0.6862 or 11/16in-0.002in

Small end bush
Ream after fitting to 0.6868-0.6863in or 11/16in-0.001in

Valve stem clearance in guide
1937-48 Inlet 0.002in Exhaust 0.003in

Valve stem diameter 1949-59
Inlet 0.311-0.312in
Exhaust 0.309-0.310in

Valve guide bore 1949-59
Inlet and exhaust 0.313-0.314in

Rocker arm bore
0.4995-0.5005in

Rocker spindle diameter
0.498-0.499in

Crankpin diameter
1.3745-1.375in

Crankshaft crankpin diameter plain bearing end
1.2495-1.250in

Crankshaft plain bearing (white metal)
Hone after fitting to 1.2515-1.252in

Camshaft bush in crankcase
Ream after fitting to 0.874-0.875in

Camshaft bush end diameter
0.8735-0.873in

Crankshaft threads
Thread for coupling gear extractor
1¾ x 20TPI
Nut securing shock absorber
11/16in x 20TPI
Nut securing front coupling gear
¾in x 20TPI
Nut securing RH crankshaft
¾in x 20TPI
Camshaft nut ¾in x 20TPI

Crankpin oil hole diameter
1/32in

Camshaft ball bearing size
¾ x 1⅞in x 5/16in

Crankshaft roller bearing in crankcase
2 lipped type 1.125 x 2½ x ⅝in

Crankshaft roller bearing in coupling gear cover
1 1.124 x 2½ x⅝in

Contact breaker gap
Magneto 0.012in
Coil ignition 0.014-0.016in

Spark plug gap
Magneto 0.015-0.018in
Coil ignition 0.025in

Timing chain
1937-48 Endless ⅜in x 67 pitches
1957-59 Duplex 8mm x 80 pitches

Magdyno type 1937-48
Lucas MN1E 180°

Distributor 1949-59
Lucas type DKX4A

Carburettor
1937-53 Solex 26AH 1954-59 SU MC2

Spares suppliers
Tim Healey Motor Cycles, Sugarbrook Works, Stoke Pound, Bromsgrove, Worcs.
Draganfly Motorcycles, 587 High Road, Leytonstone, London E11 4PB
Ariel Owners MCC (Mike McDonald), Bridleside, Anchor Lane, Wadesmill, Ware, Herts SG12 0TF.

Recommended Lubricants
Newtons, Filtrate, Silkolene, Monograde SAE 40 or 50.