

DECARBONISING YOUR MORRIS MINOR

By
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With which is coupled the process of Valve Grinding

THE accumulation of carbon deposit in an internal combustion engine is not confined to any particular example but is one of the features inherent to this prime mover; this accumulation taking place in all engines irrespective of their size and cost. Much can be done to alleviate the trouble and keep it within reasonable bounds by the careful design of the power unit generally, and the carburation and lubrication systems in particular. In the case of the Morris Minor, much thought has been expended on these items, and, as a result, this engine is very commendably free from rapid accumulation of this undesirable substance. The symptoms attending the presence of an excessive carbon deposit are now so well known as to need little introduction here, but for the benefit of the tyro we would indicate that its presence is demonstrated by a falling-off in power, accompanied by a certain harshness of running and a frequent metallic noise from the engine when pulling hard, graphically described as "pinking." This noise is somewhat similar to that produced by advancing the ignition too far, so that care must be taken not to confuse the two.

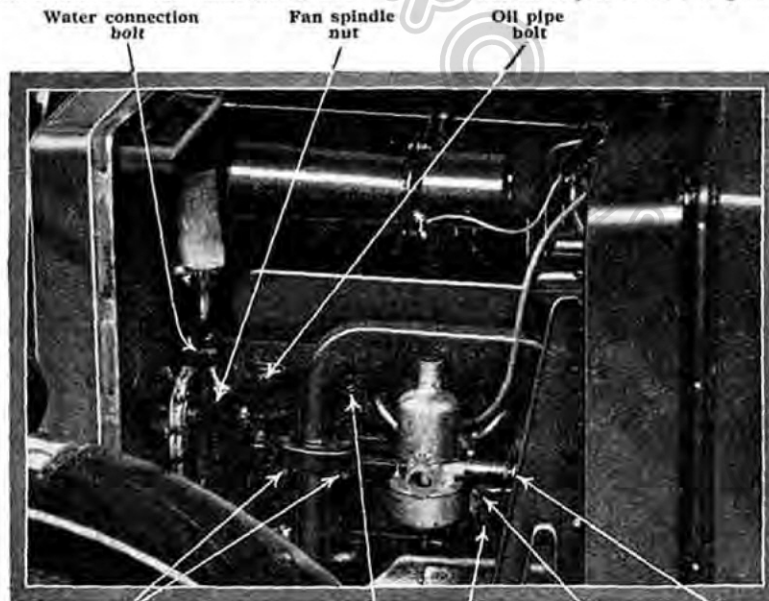
Decarbonising is not a difficult operation, and should be well within the compass of the average owner-driver who

knows how to handle a spanner and screwdriver. The special materials needed are few, and consist (in addition to the standard tool kit) of a supply of clean rags, a flat tin (a deep baking tin will do nicely), a plentiful supply of paraffin, and a tablet of Castille soap (obtainable from your chemist), or alternatively any good quality white bar soap.

If your Morris Minor has reached the stage where decarbonising has become necessary, everything points to the probability that the valves are also in need of attention. While the head is removed for the decarbonising process it is therefore just as well to grind these in, and thus ensure a further lengthy period of trouble-free motoring.

When dealing with the valves, one extra tool will be required; that is a valve spring compressing tool, which can be obtained from any Morris Dealer for the modest sum of 2s. 6d. Some valve-grinding paste is also needed.

Having gathered together the necessary material, you may start up the engine and let it run quietly until it becomes nice and warm while you don some suitable attire. You will find it much more enjoyable to work on a warm engine. Now run the car to a suitable spot and drain the radiator by means of the drain tap in the lower tank just above the



Illustrating the items on the near-side of the Morris Minor power unit which require attention before decarbonising.

Decarbonising your Morris Minor—contd.

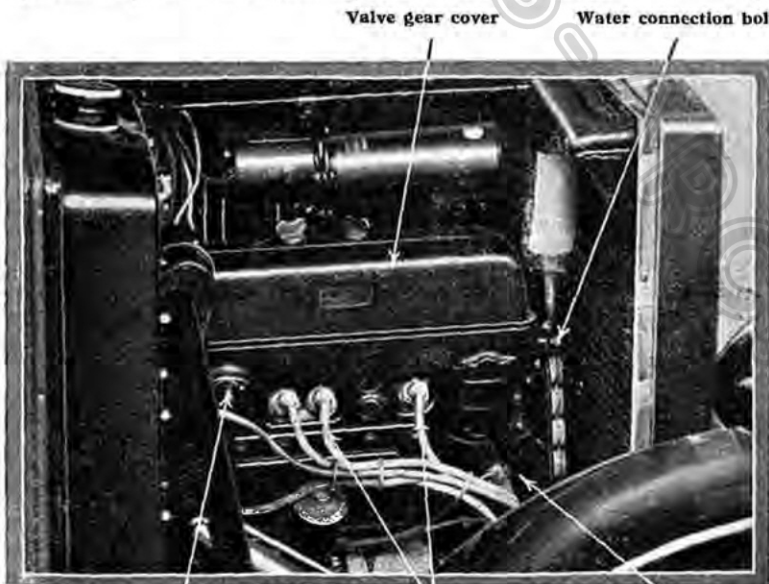
steering gearbox. Time will be saved if, while the radiator is draining, you proceed to turn off the petrol and remove the bonnet. The latter is detached by unscrewing the two bolts which attach the rear end of the bonnet hinge rod to the scuttle rim.

There is no occasion to interfere with the electric horn suspended on the radiator stay. This can be swung round until it is above the stay, where it will not interfere with the work. In the centre of the domed cover protecting the overhead valve gear will be found two large wing nuts. These should be unscrewed simultaneously, permitting the removal of this domed cover. Now relieve the fan belt from tension by slackening the fan spindle clamping bolt, thus allowing the top water connection to be disconnected from the front face of the cylinder head block without damage to the hose pipe, taking care not to lose the joint washer.

The Items that need Uncoupling

Commencing operations on the left-hand side of the engine, you should now uncouple the exhaust pipe from the manifold, the carburetter mixture control rod at its junction to the brass control lever, and withdraw the windscreen wiper tubing from its attachment to the carburetter body. The petrol pipe must also be uncoupled from the carburetter float-chamber by undoing the union at the junction between the petrol pipe and the filter. Both the induction and exhaust manifolds can then be removed by unscrewing the four retaining nuts which are found between each of the manifold branches.

Fastened to the side of the forward end of the cylinder head you will find an oil delivery pipe. Disconnect this by removing its central retaining bolt. This will reveal



Oil return pipe Sparkling plug leads Oil return pipe
Here are shown the components requiring disconnection or removal on the off-side of the power unit.

the oil flow restrictor pin beneath it. Pull on its projecting end, and if it is at all loose withdraw it and put it away carefully before it becomes lost or damaged.

You may now transfer your attention to the right-hand side of the engine, where at the front you will find a large diameter copper pipe—an oil return pipe—which should be uncoupled at its upper end by removing the two retaining nuts. There is no occasion whatever to withdraw the pipe from the studs, as these will draw straight out when the head is subsequently lifted. A very similar pipe will be found at the rear end of the engine. This one should be

uncoupled at both ends and removed bodily, care of course being taken not to lose the joint washers, and follow this by disconnecting the high-tension wires from the sparking plugs.

Between the projecting forward end of the cylinder head and the dynamo will be found a flexible coupling of the ring type, which is attached to the dynamo drive yoke by means of two bolts. Removal of these bolts will permit the flexible coupling to be withdrawn with the cylinder head.

The two bolts attaching the flexible coupling to the cylinder head yoke should not be interfered with, as these are supplied with carefully selected distance washers which may easily be lost.

The cylinder head itself is attached to the cylinder block by ten nuts, screwed on to long studs which pass right through the casting. Each of these nuts should be slackened off in rotation, half a turn at a time, until they are all quite loose, when they may be finally removed. It is not a wise policy to unscrew any one of these nuts completely before dealing with the others, as this is liable to set up local strain



The correct order in which the cylinder head stud nuts should be gradually slackened or tightened is here indicated.

upon the casting which may lead to its distortion, preventing you from obtaining a gastight joint at a later period. These nuts should preferably be removed in the order indicated in the accompanying illustration. When all are removed, the cylinder head is ready to be lifted from the cylinder block. It is possible that the joint between the cylinder block and the cylinder head will not be readily broken, in which case each side of the head may be smartly tapped with a wooden mallet, or with a hammer with a piece of wood interposed to take the blow, in order to break the joint. If this does not loosen the joint, it is permissible to insert a screwdriver, or similar blunt wedge-shaped tool, between the joint at the two places specially provided. There is one of these on each side of the cylinder head, where the gasket will be observed to have been specially cut away in order to allow of the insertion of a tool without damage. Common sense indicates that it is unwise to force the tool too far in so that it comes into contact with the gasket. Once the joint has been broken, no difficulty whatever should be experienced in raising the head clear of the studs if it is drawn squarely upwards. When withdrawn, the head should be placed on a clean bench out of harm's way, and should be followed by the copper-asbestos gasket, which should be carefully lifted straight off the cylinder head studs, keeping it parallel with the upper face of the cylinder block the whole time, so that it is not damaged or even bent in the process.

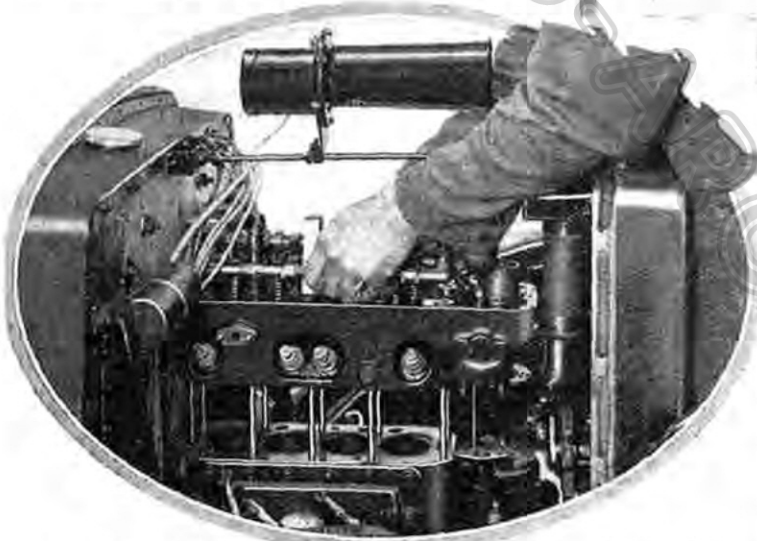
The Actual Decarbonising Operation

Everything that requires removal for decarbonising has now been dealt with, and the actual decarbonising operation may be embarked upon. Insert the starting handle and carefully turn the engine until any two of the four pistons are at the top of their stroke. Examination will show that these are encrusted with a certain amount of black deposit, and that the remaining two are at the bottom of their

Decarbonising your Morris Minor—contd.

cylinders. Two pieces of clean rag should now be requisitioned and stuffed into the open cylinder bores of the two latter pistons, so that the carbon deposit scraped from the upper two does not find its way therein. With an old screwdriver, or similar blunt tool, scrape away all the black deposit from the top of the pistons and the face of the cylinder block around the mouth of the cylinder bores, taking every care not to score the comparatively soft aluminium of the piston crowns. When as much of the carbon deposit as possible has been scraped off in the way indicated, the pistons may be further cleaned with a clean rag damped with paraffin. Under no circumstances should emery cloth or similar abrasive material be used for the purpose. It will cause nothing but trouble and is to be strictly avoided. When these two pistons have been cleaned to your satisfaction, remove the rag from the others, give the starting handle half a turn, and clean the remaining two in precisely the same way, protecting the bores of the two you have just cleaned with rag as before.

You may now give attention to the cylinder head. Remove the sparking plugs and turn the head upside down, so that the combustion chambers and the valve heads are brought to view. With your blunt screwdriver, carefully scrape away the carbon deposit on the surface of the combustion spaces and the heads of the valves, and go carefully round the edge of each valve with a small screwdriver in order to remove all trace of carbon which may still be adhering to the edges of the valve ports. With this same small screwdriver, carefully clear away any carbon deposit which may still be adhering to the sparking plug holes, and finally



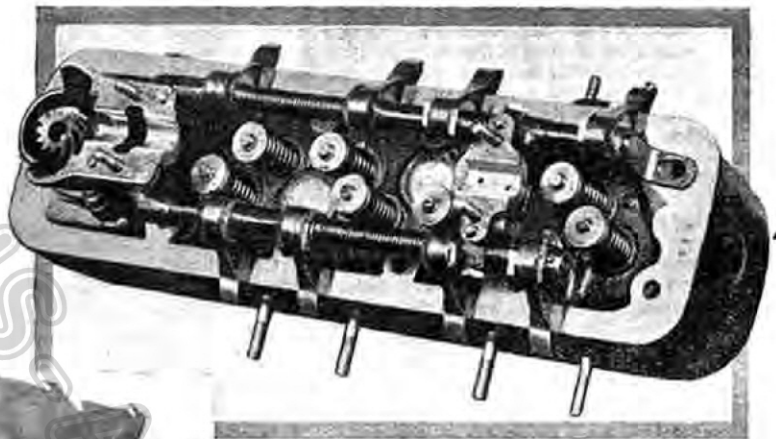
The cylinder head is most easily raised by standing in front of the radiator and holding the rocker shafts.

thoroughly clean both combustion chamber and valve heads carefully with rag moistened in paraffin.

Now place the cylinder head on the bench the right way up, so as to obtain access to the valve springs, which are at present partly obscured by the camshaft and rockers. The former must therefore be removed—not by any means a difficult matter—if the valves are to be withdrawn. The camshaft is held in position by two retaining caps, each of which is attached to the cylinder head by two studs and nuts. Each nut in sequence should be given half a turn at a time in a similar manner to the cylinder head retaining nuts, until they are eventually removed. This will permit the camshaft to rise evenly and avoid its distortion. Removal

of the retaining caps will enable the camshaft to be lifted from its bearings and completely removed by passing it through the valve cover saddles. Once the camshaft is no longer in position, the valve rocker-arms can be swung clear of the valves, giving free access to each valve spring.

Here it will be necessary to bring into use a small wood block, slightly greater in thickness than the depth of the combustion spaces and a free fit within them. Slightly raise the cylinder head from the bench, and slip this block into the combustion space, so that the valve heads are resting hard upon it. This will allow the valve springs to be compressed with the special valve tool designed for the purpose without forcing the valves open. Compression of the springs with the help of the special tool will expose two small conical cotters engaging in a groove cut in the end of the pencil-like stem of the valve. If these cotters are removed from the groove the valve spring cap is then free to rise beyond the end of the valve stem and release the valve



This view of the upper face of the cylinder head shows how the valve rockers can be swung clear of the valves when the camshaft and cover saddles have been removed.

spring. Repeat the operation on the spring of the other valve belonging to this combustion space. When both these springs have been removed the head may be raised from the bench, and the wood block withdrawn, thus allowing the valves to be withdrawn from their guides.

An examination of the valves will reveal that their mushroom-like heads are bevelled off at an angle which corresponds with the similar bevelled edges of the valve ports in the cylinder head. It is the quality of the joint between these two bevelled surfaces which determines the degree of gastightness existing in any particular cylinder when the valves are closed. Obviously, a high degree of gastightness cannot be attained if these bevelled surfaces are dirty or corroded, and it is therefore necessary to clean them up so that they make perfect contact over their entire surface by the process known as "grinding-in." Since it is

of some importance to make sure that the valves are ground into the same port from which they were taken, on the Morris Minor engine each valve has stamped upon its head a number giving its position and corresponding with a similar number on the lower face of the cylinder head adjacent to each valve port.

Making the Valves Gastight

Grinding-in the valves consists of coating the bevelled face of the valve with a small quantity of grinding paste applied smoothly and evenly, and, after reinserting the valve in its guide, partially rotating it backwards and forwards on its seating with the help of a screwdriver, until

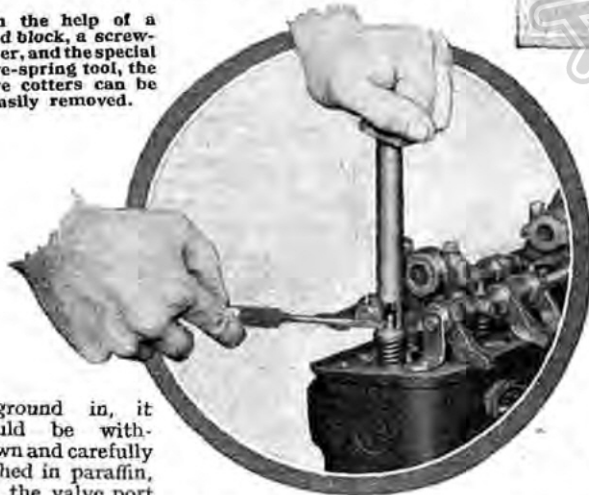
Decarbonising your Morris Minor—contd.

both the bevelled surface of the valve and the valve port are quite clean and make perfect contact. The whole secret of good valve grinding lies in the prevention of the formation of circular grooves on the bevelled surfaces, and this is effected by raising the valve from its seating every half-dozen reciprocations and giving it a half turn before bringing the surfaces to be ground into contact again. By this means the grinding compound is spread evenly over the entire surface, so that no difficulty will be experienced in obtaining a perfectly satisfactory gastight joint. Periodical raising of the valve in this manner will be greatly assisted if a light spring is inserted into the valve port beneath the valve head, so that when pressure is released on the screwdriver the valve will pop up and facilitate its rotation into the fresh grinding position. Excessive grinding-in of the valves is to be avoided. It is quite unnecessary to continue grinding the valves after the faces of both the valve and the seating have assumed a clean, even, matt-surfaced appearance. A polished surface is not to be expected and is indeed quite unnecessary.

Valves that are Pitted

Very frequently, when the engine has been run for a long period without being decarbonised, the valve faces assume a spotted appearance. Closer examination of these spots will show that they are in effect small "pits" or depressions in the face of the valve. If the valve is badly "pitted" in this way, it is best to have the valve face trued up on a special machine at a garage in order to prevent needless grinding away of the valve seating in the cylinder head—a serious matter, as these cannot be renewed. Any valve which shows signs of distortion should immediately be replaced by a new one, and no attempt should be made to grind it in, as only extensive damage to the seating will result. Immediately after each valve

With the help of a wood block, a screw-driver, and the special valve-spring tool, the valve cotters can be easily removed.



is ground in, it should be withdrawn and carefully washed in paraffin, and the valve port

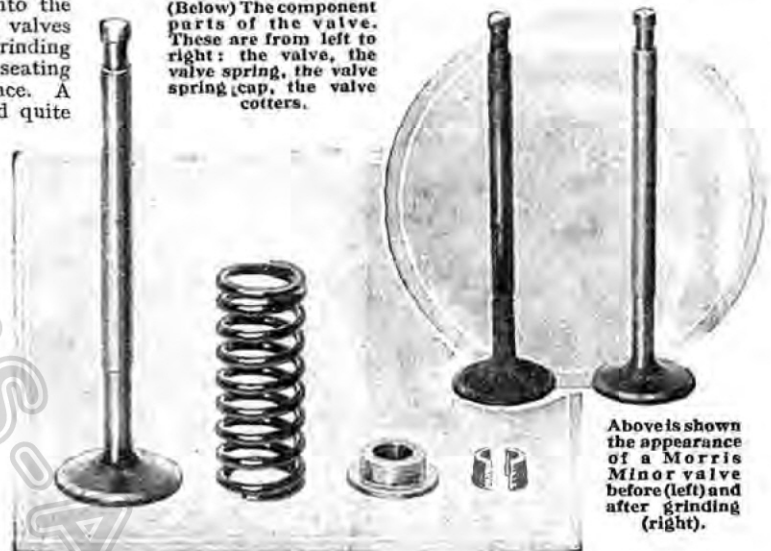
and seating should also be cleaned. Do not swill out the valve ports with paraffin or some of the grinding compound will probably find its way into the valve guides and other working surfaces, causing extensive damage. The valve ports should be cleaned out with a rag damped in paraffin, used with care.

Having satisfied yourself that every trace of the grinding compound has been removed, the valves may be reassembled. Care should again be taken to see that they are in their correct ports. Reassembly of the valve is not a difficult matter with the aid of the special valve tool. After inserting the valve in its guide and resting its head on the wood packing block as before, the valve spring is placed in position with the valve spring cap resting on top of it. Engage the valve tool on the cap, depress the spring so as to expose

very nearly the whole of the groove in the upper end of the valve stem, and insert the two conical cotters into the groove, small ends downwards. You may now gradually release the spring and the valve is assembled. Make sure that the cotters are in proper engagement with their grooves before dealing with the next valve, and if the valve cover saddles have been removed do not forget to replace them in position before reassembling the valves which are between the camshaft bearing brackets, or you will find that these springs are in the way and prevent you from replacing the saddles.

When all the valves are in position, the valve rockers can be swung into position into engagement with their respective valves and the camshaft replaced. When replacing the camshaft it is important to note that the two marked teeth

(Below) The component parts of the valve. These are from left to right: the valve, the valve spring, the valve spring cap, the valve cotters.



Above is shown the appearance of a Morris Minor valve before (left) and after grinding (right).

of its bevel wheel engage on either side of the marked tooth of the driving pinion. When you are satisfied that these teeth are in proper engagement, the camshaft bearing caps can be placed in position and their retaining nuts screwed on to the studs. Since these bearing caps are dowelled into the bearing brackets, there is no possibility of misalignment, but considerable care should be exercised to tighten the bearing cap nuts evenly. Each should be given a partial turn at a time, as before, until all are perfectly tight, in order to prevent camshaft distortion.

The need for Readjustment of Valve Clearances

The grinding-in process removes from the valves a certain amount of metal. This tends to reduce the clearance existing between the head of the valve and the under-surface of the rocker-arm. Now it is essential for the proper functioning of the engine that this clearance should never be less than .003 in., and it is therefore necessary at this stage carefully to check the clearance of each valve with the feeler gauge attached to one of the special rocker adjusting spanners. Before attempting to adjust this clearance, see that the cam operating the particular valve to be adjusted has its peak pointing directly upwards. When you have got it into this position, you may engage the plain rocker adjusting spanner on the bronze nut, which will be found on one side of the rocker. Holding this bronze nut in position, slacken the steel nut on the other side of the rocker with the spanner having the feeler gauge attached. Withdrawing the spanner from the steel nut, insert its feeler between the valve rocker and the cam, and rotate the bronze nut until the feeler gauge can just be withdrawn easily. Now, retaining the spanner engaging the bronze nut exactly in this position, firmly tighten up the steel lock nut. The clearance should then again be checked to make sure that no movement of the setting took place during the re-locking process. Very little

Decarbonising your Morris Minor—contd.

rotation of the bronze nut is required to effect the required adjustment, and it should not be moved round too far. It is of some importance that the thick portion of the eccentric bush on which it is formed should be towards the centre of the engine, or the oil supply to the cam will be cut off, with disastrous results.

All valve clearances having been correctly adjusted, the cylinder head can be replaced. It is of course necessary thoroughly to clean the gasket and remove any carbon deposit which may be adhering to its edges. The Castille soap should now be brought into use, an even film of this commodity being applied to both sides of the gasket by the simple process of rubbing the tablet over its surface. If you have been so unfortunate as to damage or bend



(Left) The timing marks on the camshaft bevel wheels. The marked tooth of the driving pinion should engage between the marked teeth of the camshaft bevel.

the gasket during its removal, make no attempt to use it again. Get a new one from your Dealer immediately. A leaking gasket is nothing but a source of continual trouble. When fitting a new gasket take particular care that it does not burr up around the stud holes and that the cylinder openings are clear of the cylinder bores themselves. If difficulty is experienced in threading the gasket over the studs, a box spanner and gentle persuasion will be found effective in coaxing it into position. It is essential that the gasket should be kept parallel with the cylinder head during the whole of the process, and not forced down at one end before the other.

Setting the Timing

You should now turn the camshaft until the timing marks on the spiral bevel drive gears coincide, and then rotate the engine by the starting handle until Nos. 1 and 4 pistons are at the very top of their stroke, with the metal electrode on the distributor rotating arm pointing towards No. 1 contact stud. No. 1 cylinder is the one nearest the radiator, and No. 1 stud is easily located by tracing the high-tension lead from this sparking plug to its junction on the distributor cover. When the distributor cover is removed, the position of the metal electrode on the distributor rotating arm can be seen, and its position relative to this stud noted. Provision is made to enable the operator to ascertain easily when the pistons are precisely at the top of their travel. Removal of the centre sloping floorboard will reveal a rectangular plate on the clutch housing just in front of the change speed

lever. Removal of this cover will enable the flywheel to be seen, and if the engine is slowly rotated a vertical line between the figures 1 and 4 will be revealed. The flywheel should be turned until this mark is exactly in the centre of the opening in the clutch housing, in which position pistons Nos. 1 and 4 will be exactly at the top of their stroke.

Replacing the Head

Having now made sure that the pistons and camshaft are correctly positioned, the head may be lowered into position on to the cylinder block. This should bring the two holes in the flexible coupling very near those on the drive yoke of the dynamo. If they do not exactly coincide, rotate the drive yoke attached to the cylinder head until the bolt holes of the flexible ring exactly coincide with those of the dynamo yoke. Insert the flexible coupling bolts and screw up the nuts finger-tight. Now replace the ten cylinder head nuts and tighten them up gradually in the order indicated in the illustration, half a turn at a time, until they are all quite tight. You may now finally tighten up the flexible coupling bolts and replace the oil pipes, exhaust and inlet manifolds, carburettor controls, petrol pipe, wind-screen wiper tubing, sparking plugs, high-tension cables, and finally the valve cover. When replacing the oil pipe at the left-hand side of the head, do not forget to insert the oil restrictor pin, and make quite sure that it is perfectly clean before doing so.

You may now fill up the radiator with water and start up the engine, letting it idle quietly until it reaches its normal running temperature. Then, switching off, remove the valve cover and go over each of the cylinder head nuts in turn, giving each a final tightening up. You will probably find that now the engine is warm you will be able to give each nut half a turn or so. Make no attempt to speed up the engine until you have accomplished this final tightening up. Before replacing the valve cover, start up the engine and observe if oil is exuding from



(Above) Illustrating the use of a light spring under the valve to facilitate grinding.



(Right) The timing marks on the flywheel indicating top dead centre for Nos. 1 and 4 cylinders.

each of the small oil passages drilled in the valve rocker-arms for the purpose of lubricating the cam surfaces. If oil is flowing freely from these passages you may replace the valve cover and the bonnet, thus completing the work.

Whenever mechanism is disturbed, a certain amount of settling always takes place. It is therefore always profitable at the end of an additional 250 miles carefully to check the valve clearances and tighten up all the cylinder head nuts in order to maintain maximum results.