REPAIR AND MAINTENANCE OF THE AUSTIN 10-H.P. ENGINE

By W. T. MEAD, M.I.M.T.

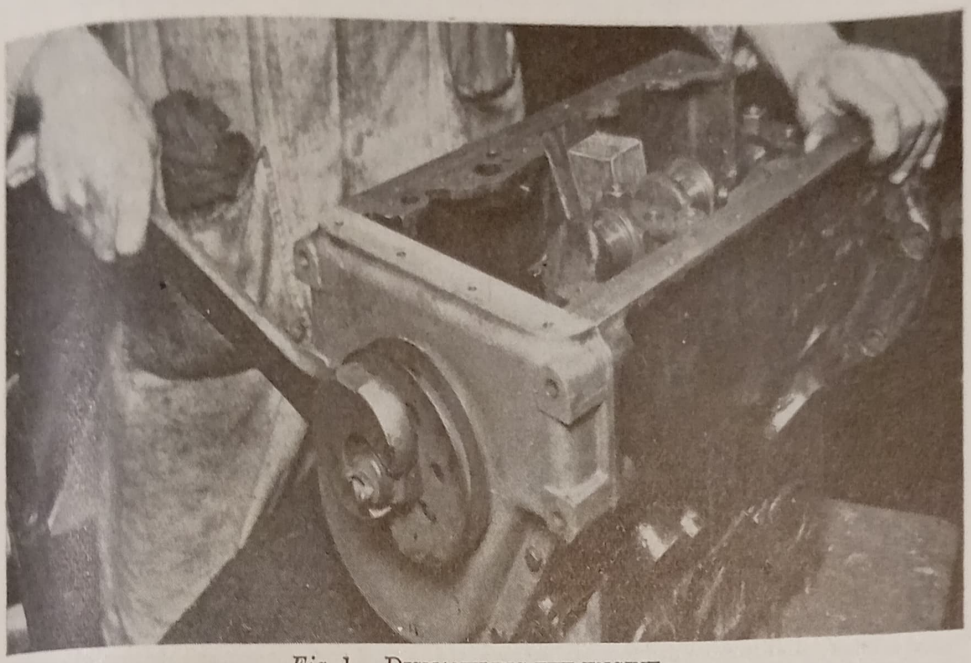

Fig. 1.—DISMANTLING THE ENGINE

Wedging the crankshaft with a block of wood whilst starting dog nut is removed.

BEFORE carrying out any repairs to the engine, test it; even though one has a specific order for certain work the test should still be carried out. For instance, the owner may give instructions for new pistons or rings to be fitted, and at the completion of the work, during the test, the main bearings may be found to be faulty, necessitating the complete stripping out of the engine and duplication of the work already done.

Having carried out the test, a decision can be made as to whether the engine should be completely dismantled for a thorough overhaul or only the head, sump, pistons, and connecting rods removed. The deciding factor is the condition of the main bearings. If they are in good condition, any other work necessary can be carried out with the engine in the frame—even to the extent of reboring, now that efficient suction plants can be obtained for carrying away the waste metal. Engineers' opinions differ as to the extent of wear necessitating reboring, but my own experi-

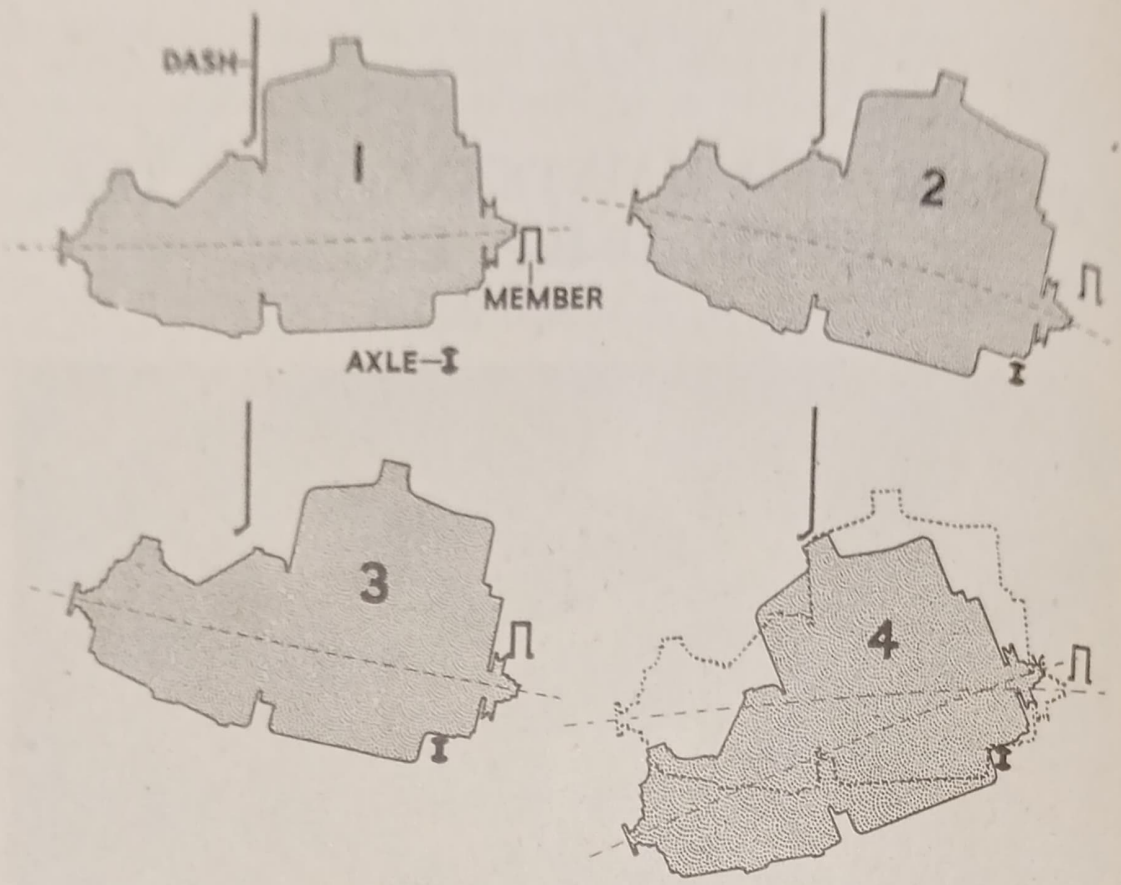

Fig. 2.—Removal of the rubber-mounted "Ten" engine involves careful manœuvring

1. Normal mounted position. 2. Lower engine and raise gearbox end of unit. 3. Push engine forward and lower until front of sump rests on axle. 4. Continue to lower, allowing the engine to pivot on axle.

ence is that Wellworthy rings will deal adequately with piston slap or over-oiling up to ·007-in. taper wear, and any amount of ovalisation likely to be met with.

We will, however, deal first with the removal and overhaul of the engine.

Removal of the Engine

The engine is withdrawn from below the chassis, and the procedure is as follows :

Remove the cushions and push back the front seats, or remove the seats entirely if preferred. Remove the nearside battery-box cover and disconnect the battery earth wire. Remove the front floor covering. Remove the bonnet, by taking off the rear hinge bracket ; the bonnet will move backwards and up when the hinge is clear of the front bracket. Be careful not to scratch the paint on the scuttle when doing this.

Now drain out the water. Take off the clutch pedal after loosening

the clamping bolt. Unscrew the change-speed knob, then take out the ten screws of the draught and fume excluder; the excluder will now pull off the top of the box and up over the lever.

Disconnect and take away the dynamo and belt, top water hose, the distributor cap and wires. Take out No. 4 sparking plug. Then the two set-screws holding the oil-filler tube, and remove it. Remove the three setscrews with fibre washers holding the water inlet to crankcase. Disconnect the oil pipe from the crankcase. Take off the air-cleaner from the carburettor, disconnecting the petrol pipes, the throttle control and strangler, and remove the carburettor. Take off the four brass nuts holding the exhaust pipe to the manifold. Disconnect the flexible petrol pipe from tank to pump. Disconnect the earth and starter wires. Detach the speedometer drive from the gearbox. Remove the bolts connecting the front universal joint to the third-motion shaft flange.

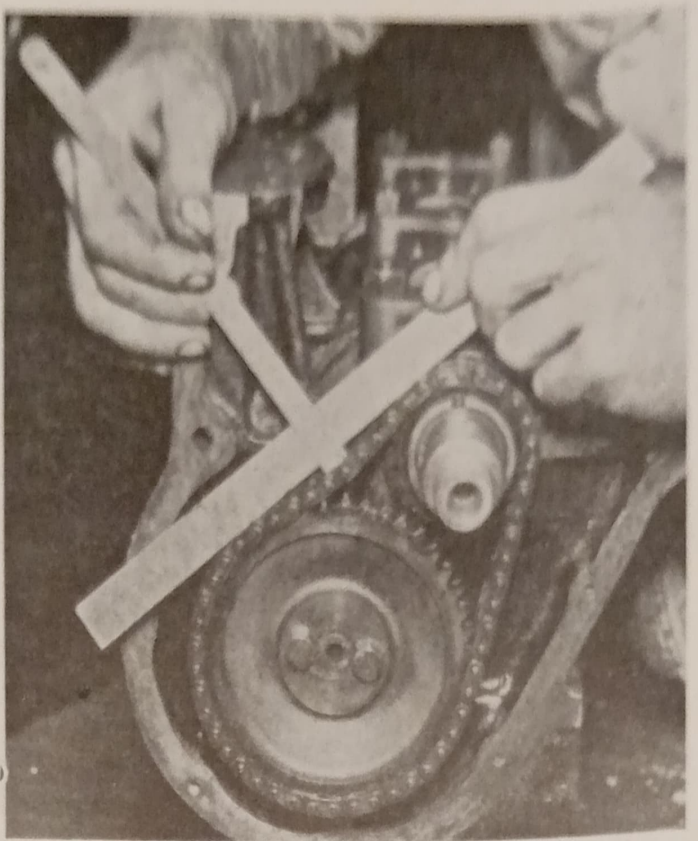

Fig. 3.—CHECKING THE WEAR ON THE TIMING CHAIN

Before starting on the engine mountings take the weight of the engine on tackle, fixing the sling around the engine in line with the petrol pump. Remove the nuts of the front mounting bolts. If the bolts are tight they should be levered out. Remove the rear gearbox mounting. Unscrew the lever from the top of the box. It is necessary to remove the nearside accelerator-shaft bracket and raise the shaft until it rests on the dip-switch, so that the engine clears during removal; also remove the near-side engine suspension bracket to allow clearance.

Use care in removing the engine, and proceed in the following manner, with assistance: Keep the gearbox end of the engine well up and lower the front end of the engine until the starter dog is just below the front member. Draw the engine forward and lower until the front end of the sump rests on the front axle. Now lower the rear end, allowing the front

Fig. 4.—TESTING FOR SLACKNESS OF GUDGEON PIN IN CONNECTING ROD

end to pivot on the axle and keeping it as far forward as possible. In this manner the rear end of the cylinder head and the top of the water outlet will just miss the engine dash. When clear of the dash the engine can be moved back and lowered to the ground or down the pit (Fig. 2).

Dismantling the Engine

The engine having been removed from the chassis, proceed in the following order: Remove the gearbox from the engine. Remove, in order, the distributor, petrol pump, starter motor, cylinder head, valves, springs, and cups. The split-type cotters are standard on present-model engines.

Remove the sump and take off the oil pipes and oil pump. Knock up the locking plates, take off the big-end caps; they draw out from the opposite side to the camshaft. All parts are numbered except the connecting rods, and No. 1 starts at the front end of the engine. Take off the front engine brackets.

Place a small block of wood between a web of the crankshaft and the inside of the crankcase to prevent the crankshaft turning, and take off the starting dog nut (Fig. 1). A smart blow on a set-spanner will release it.

Checking Timing Chain Wear and Removing

Remove the front engine cover. Now check the timing chain for wear before removing it. Place a foot rule edgeways along the top of the chain from the crankshaft to the camshaft gears (Fig. 3). Press the slack away from the rule and measure the distance; if more than $\frac{1}{4}$ in., fit a new one; it would still run for a long time but it would be noisy at low speeds. To remove the chain, which is the endless type, take out the two setscrews holding the camshaft gear to the camshaft. Now draw off the crankshaft gear with a claw-drawer: take care not to bruise the teeth

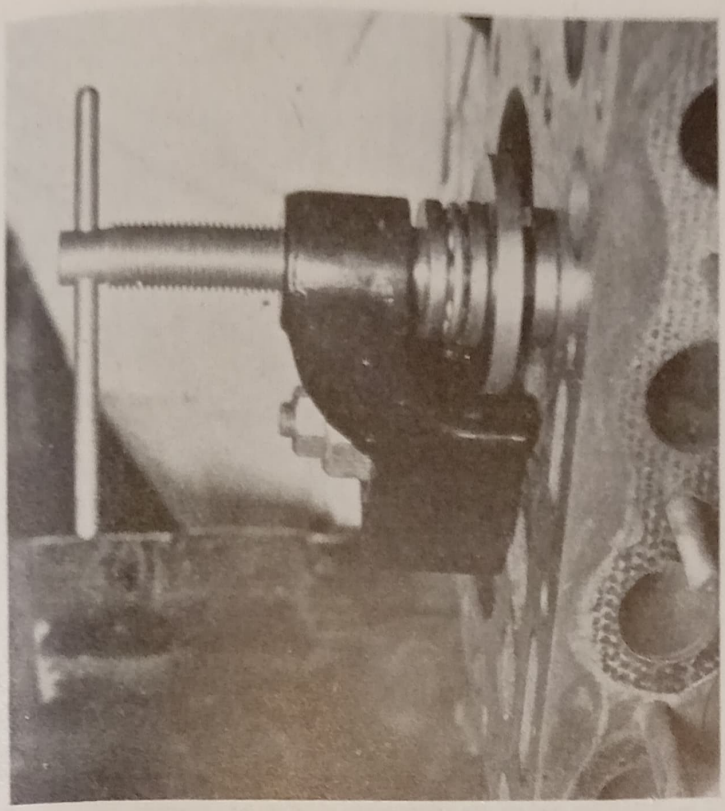

Fig. 6.—PRESSING IN THE VALVE-SEATING INSERT WITH THE BUMA TOOL

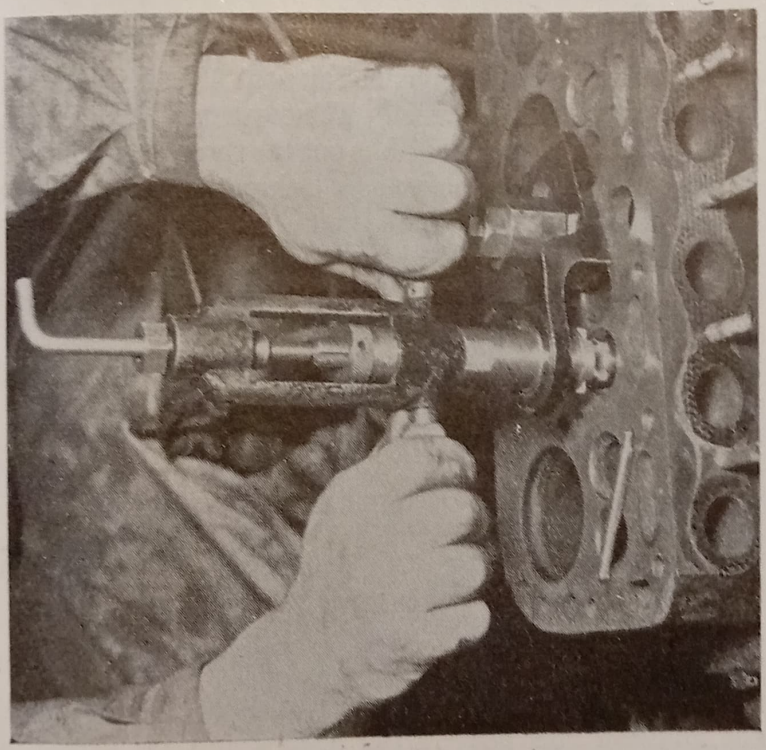

Fig. 5.—USING THE BUMA VALVE-SEATING INSERT CUTTER

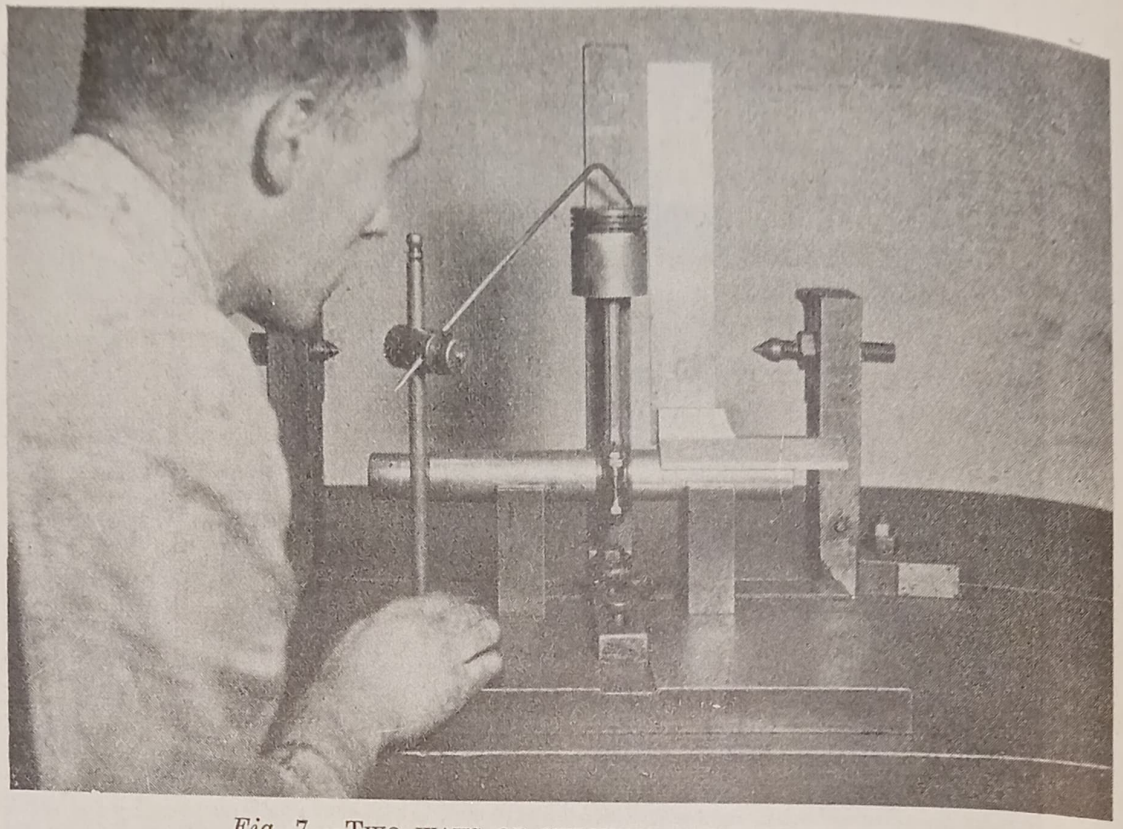

Fig. 7.—TWO WAYS OF CHECKING PISTON ALIGNMENT
Across the top with a scribing block and up the side with a square.

Dismantling Flywheel Assembly

Next, from the rear end of the engine take out the six setscrews that hold the flywheel cover to the flywheel. The cover will then come away, bringing the clutch assembly with it. Take out the three screws holding the flywheel-bearing cover which acts also as a locking-plate for the flywheel bolts, of which there are six ; knock the bolts out, they will each in turn pass the rear bearing after removal of the cap. The flywheel can now be gently levered off. A drift can be used against the back of it through the starter hole in the clutch housing if necessary. When levering off the flywheel remember the housing is aluminium, and do not use too much force.

Removing Crankshaft and Camshaft

Remove the crankcase rear cover. Take out the setscrews holding the aluminium flywheel housing to the crankcase. When the housing is off, carefully remove the crankshaft oil spinner. Take off the main-bearing caps and the crankshaft will lift out. Now remove the tappets and pull out the camshaft from the front. Thoroughly clean all parts.

Examining for Wear

Take off the piston rings and disconnect the connecting rods from the pistons. The gudgeon pins float in the pistons and are locked in the

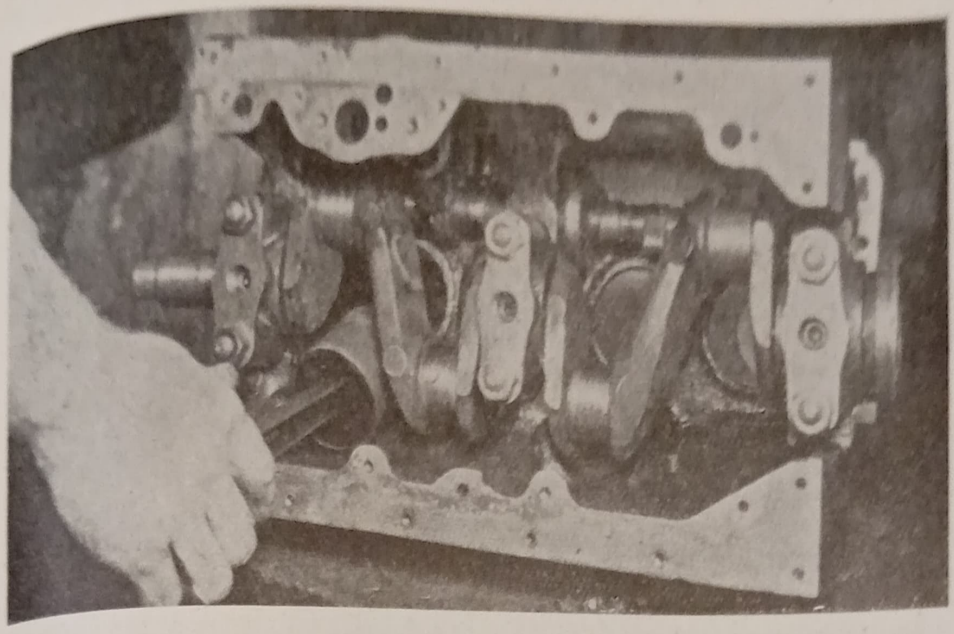

Fig. 8.—REFITTING CONNECTING ROD AND PISTON

Passing the piston between the crankcase and crankshaft on the opposite sides to camshaft.

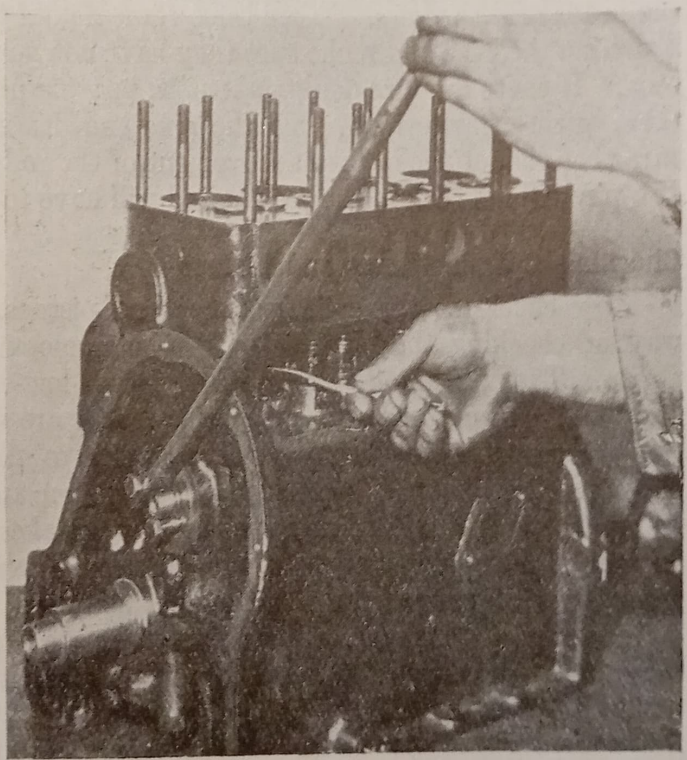

Fig. 9 (*right*).—SETTING THE VALVE TIMING

Place the lever between the two screws at the end of the camshaft and revolve the camshaft until No. 1 inlet valve starts to open. This can be checked with a ·002-in. feeler, as shown. Now turn the flywheel until the timing marks on it register T.D.C. The timing wheels and chain may now be placed in position.

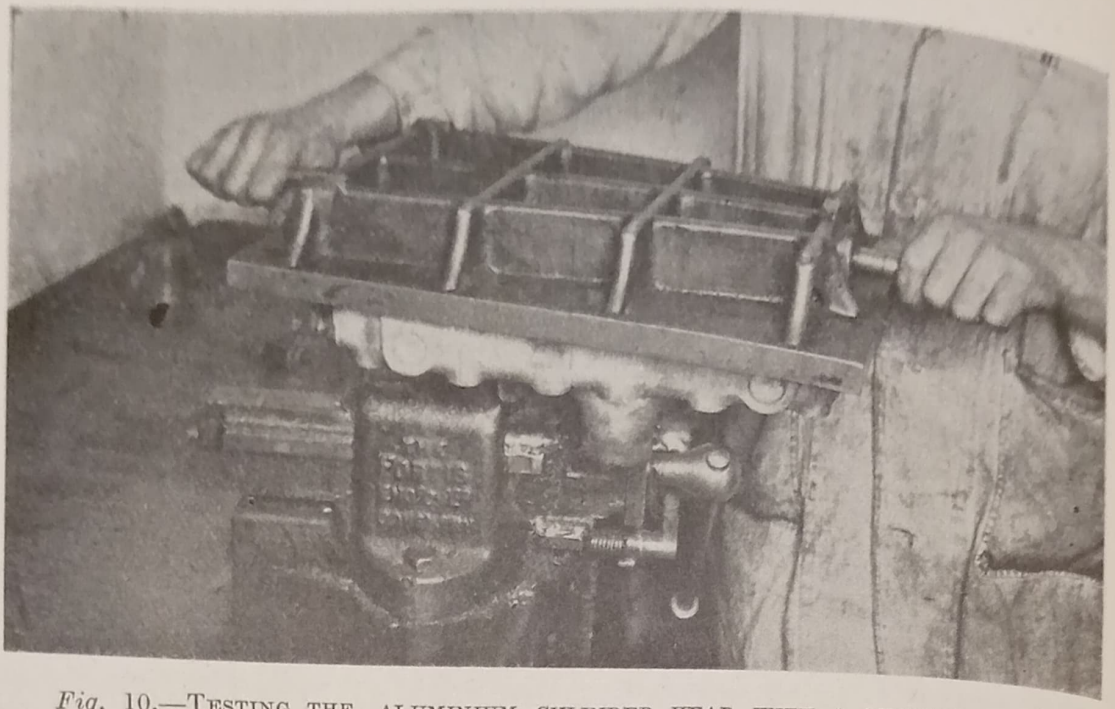

Fig. 10.—TESTING THE ALUMINIUM CYLINDER HEAD WITH A SURFACE-PLATE

connecting rods by $\frac{5}{16}$-in. B.S.F. setscrews. Knock up the lock-washers under the setscrews, and use a good-fitting hard-jawed set-spanner to remove the screws. Take care not to let the spanner slip and chew up the heads of the screws. When the screws are out the pins will push out. Examine the pins and make sure they have not moved in the connecting rods. If there are any doubts about it, put the pins into the rods, lock them with the setscrews, hold the pins endwise in the vice and make sure there is not the slightest movement of the rods on the pins (Fig. 4). If a pin will not lock in the rod the rod will have to be renewed.

Checking Cylinder Bores and Pistons

Now check up the cylinder bores and pistons. The most efficient way of checking the bores is with a micrometer or micrometer bore gauge. The pistons fitted are a special low-expansion aluminium alloy and are anodised after machining ; they are slightly oval in shape, the greater diameter being at right angles to the gudgeon pins, the clearance here between the skirt of the piston and the cylinder walls being ·003 in. It will be seen that little wear takes place on the pistons, any found being in the bores of the cylinders. The manufacturers supply three sizes of pistons for this model : standard, $\frac{1}{64}$ in. oversize, and $\frac{1}{32}$ in. oversize. To each of these sizes there are three grades of pistons ; they are marked thus : 1, 2, 3. No. 1 is the exact size of bore ; No. 2, ·0005 in. oversize ; No. 3, ·001 in. oversize. It will be seen, therefore, that some scope is allowed for piston selection and fitting. If no reboring

plant is available, the manufacturers have an exchange scheme for rebored blocks. Although Wellworthy rings would make an efficient repair in the case of wear up to ·007–·008 in. if the engine was not dismantled, it is advisable in the case of a complete overhaul to rebore if the wear is more than ·003 in. It is, of course, very doubtful if the engine would have been dismantled unless the wear was more than this.

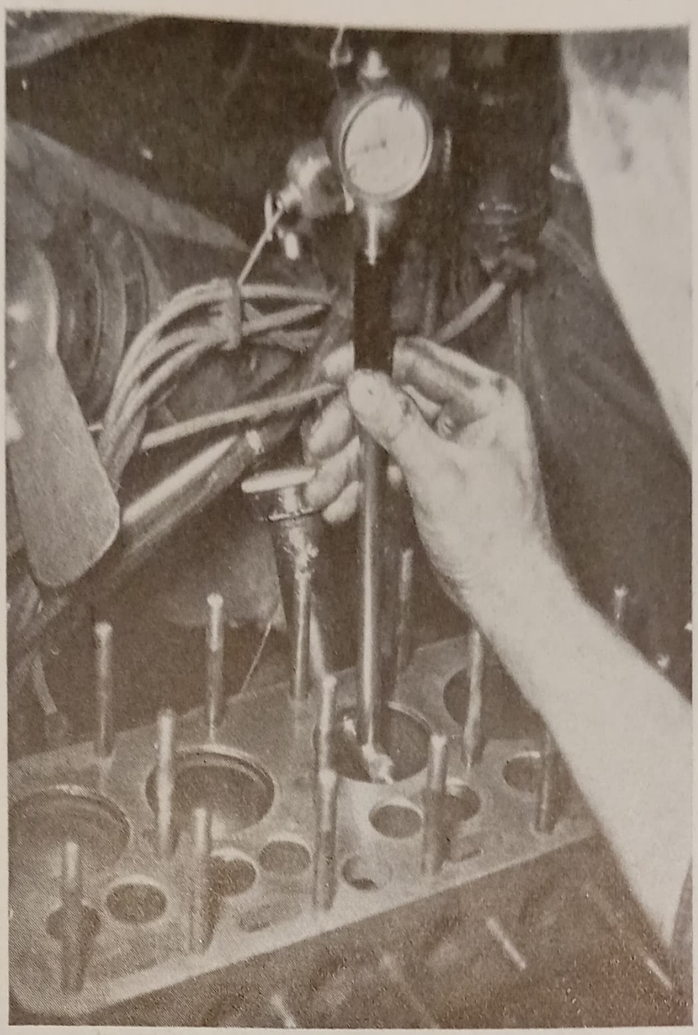

Fig. 11.—USING THE MERCER BORE GAUGE

The Valve Gear

Carry out a careful examination of the valve guides and seats. If new guides are necessary, the old ones can be driven out from the top and new ones driven in from the same direction. The distance from the top of the guide to the top of the cylinder block should be $1\frac{1}{8}$ in. If new guides are fitted, the seatings should be recut. It should always be borne in mind that as little metal as possible be cut from the block when using a valve-seating cutter. Although it is very unusual to find a seating so wide or burnt as to make it unserviceable, it is possible to machine out the block and fit an insert in such circumstances.

Fitting Valve-seat Inserts

Figs. 5 and 6 show a Buma cutter being used. This is a universal tool which cuts the block and presses in the insert. It is advisable to fit a new valve guide when fitting an insert.

When the seatings have been reconditioned as necessary, examine and test the valves—in a valve-grinding machine, if possible, or else on a

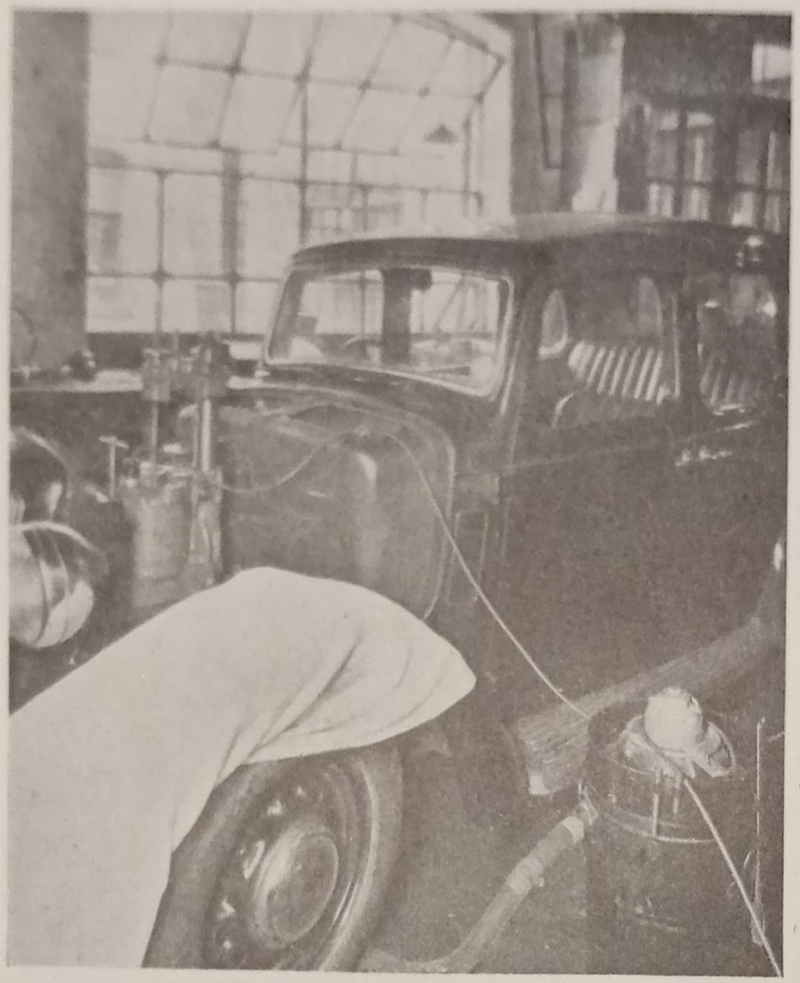

Fig. 12 (*left*).—REBORING THE ENGINE IN POSITION

This picture shows the Van Norman borer and Buma suction plant being used.

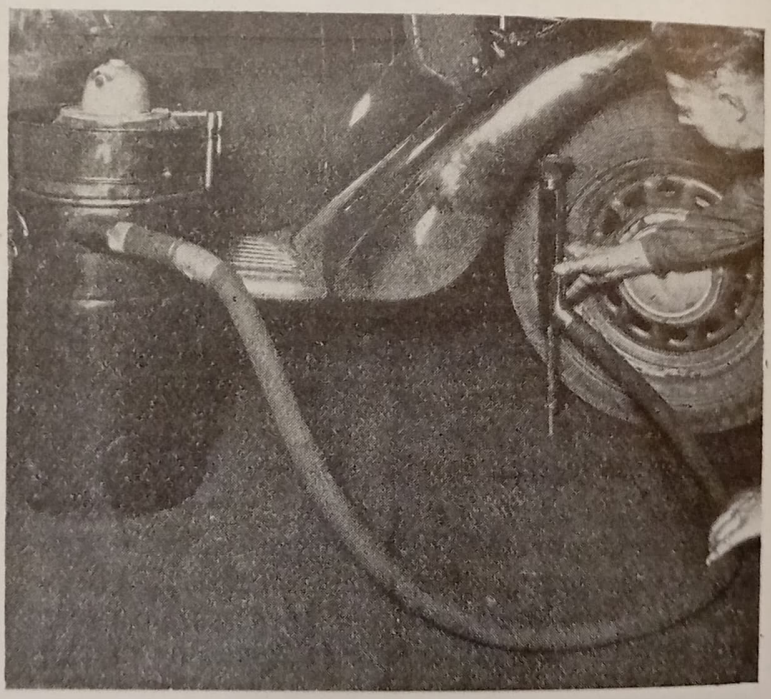

Fig. 13 (*right*).—THE BUMA SUCTION PLANT

Showing the rubber cup for fitting at the bottom of the cylinder bore on an adjustable leg. Rubber cups of varying sizes are supplied.

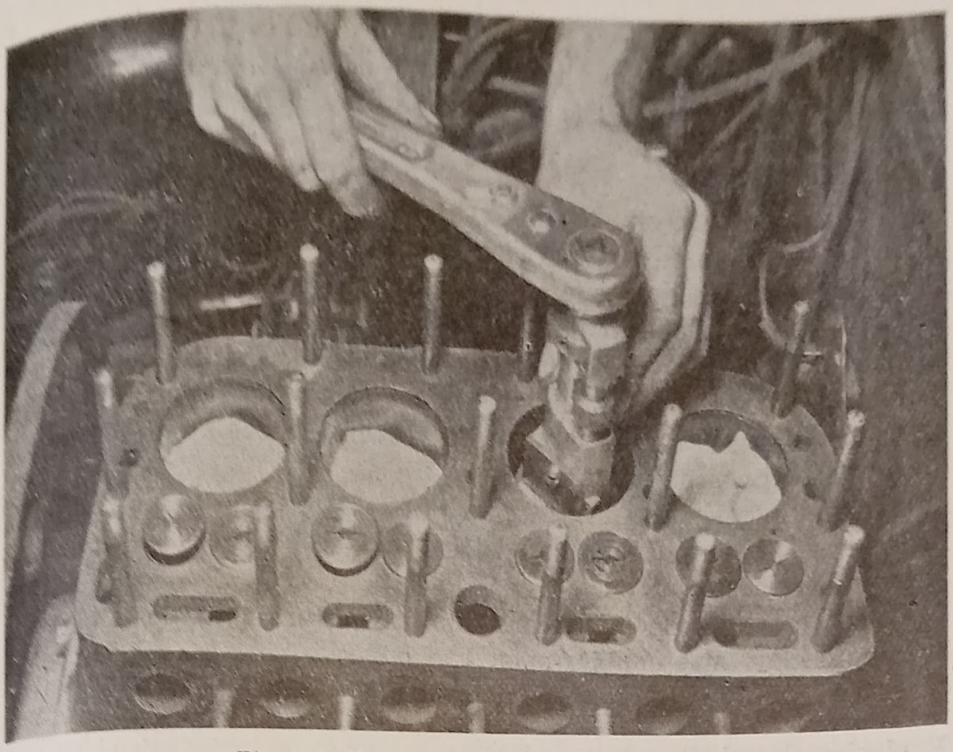

Fig. 14.—USING THE RIDGE-REMOVING TOOL

lathe. If any of the exhaust-valve seatings are badly distorted, replace the valves; they are not very expensive, and there is a risk that even if trued up they may go again. Check all stems and if worn renew them. The valve should seat about half-way down the chamfer. If the seating takes place too near the outer edge the valve will pocket and burn. Finally grind them all in very carefully.

Inspect all tappets and renew any which have flats worn on the radius; dress the heads of the tappet screws or renew them if necessary. Check the valve springs; if weak replace them.

Examine the camshaft and oil-pump gear. Check the oil pump, the only part needing attention should be the bottom face. This will probably be recessed and need facing. The camshaft runs in bi-metal bearings and no excessive wear is likely to be found here. If new ones are needed it is a job for the manufacturers, because they are all different sizes and a special reamer is necessary.

The Crankshaft and Bearings

The crankshaft and bearings should now be examined. High-precision type bi-metal bearings are fitted, they need replacing only if slack, and on no account should any attempt be made to scrape them or file the caps. There should be ·002-in. clearance between the bearing and the journal. If the journal is so badly worn that a new standard bearing is too slack, the shaft should be ground down, and special under-

size bearings fitted. These particulars apply also to the connecting-rod bearings. The thrust on the crankshaft is taken on bronze washers fitted to No. 3 bearing. The shaft should have ·003-in. end float.

Fitting the Pistons

Having fitted the crankshaft to the crankcase, fit up the new pistons to the connecting-rods. Take care to tighten the gudgeon pin in the connecting rod, but do not forget the screw is only $\frac{5}{16}$ in. B.S.F., and do not shear the head. Now line up the pistons to the connecting rods; there are several popular alignment tools on the market now, or one made as shown in Fig. 7 will do the job. This is a particular operation, to which sufficient care is not always shown. It has a big bearing on bore wear, oil consumption, etc.

Piston rings should have a gap of ·006 in. The present type of piston has three rings above the gudgeon pin, the bottom being a slotted type used as a scraper ring.

When refitting the connecting rods and pistons, pass them between the crankshaft and crankcase on the opposite side to the camshaft (Fig. 8).

Replacing Camshaft

Having fitted the pistons and connecting rods, replace the camshaft. Inspect the camshaft and crankshaft gears, and if worn replace them. If new ones are fitted make sure they are in line, they can be lined up by fitting shims behind the crankshaft pinion. The camshaft gear fits with the dished side to the front cover.

Flywheel Housing

Now fit the aluminium flywheel housing with a new brown-paper washer between it and the crankcase. Do not make the mistake of fitting the sump before doing this, or the result will be an oil leak.

Worn Starter Ring

Before refitting the flywheel examine the starter teeth; if they are worn, the old starter ring should be machined off and a new one obtained. This should be heated to a temperature of 200–250° Centigrade, in an oil bath or on a steel plate over a gas-ring. At this temperature it should be placed on the machined portion of the flywheel, taking care the teeth are the right way, with the lead on the teeth towards the starter-motor position. The manufacturers will exchange the old one for one with a new ring.

Fitting Flywheel

Before fitting the flywheel make sure the oil spinner is running true on the end of the crankshaft and fit a new washer behind the crank-

shaft cover. Fit the flywheel with the timing marks corresponding to the crankshaft; use a new brown-paper washer between it and the crankshaft. Now fit the valve tappets, then the valves and springs.

Timing the Engine

To time the engine, take off the camshaft gear now it is lined up, and screw the two holding screws back into the shaft. Adjust the tappet clearance on No. 1 inlet valve ·003 in. Now with a lever between the screws at the end of the camshaft revolve it until No. 1 inlet valve starts to open. This can be checked with a ·002-in. feeler (Fig. 9). Now turn the flywheel until the timing marks 1–4 are T.D.C. Now take out the screws from the camshaft end and fit the camshaft gear and timing chain. Now turn back the flywheel until the timing marks are $\frac{3}{4}$ in. B.T.D.C. Then insert the distributor with the pointer in the middle of the scale and the points about to break with the rotor opposite No. 4 electrode on the distributor cap. Before fitting the distributor make sure the contact points are in good condition and the automatic advance and retard working freely. Check the springs of the balance-weights, and if they appear weak renew them. The final fine-ignition setting should be done on the road test. Now fit the oil pump and the oil service pipes.

Fitting the Aluminium Head

Before fitting the cylinder head check it on a surface-plate and if there is any distortion dress it up (Fig. 10). Take care to fit the correct type of gasket to correspond with the water slots. Take particular care to pull the head down evenly, starting from the middle, then the opposite corners, and working back to the middle again (this is more important with an aluminium head than with a cast-iron one).

Check the sparking plugs and fit a new set if the electrodes are burnt.

Replacing Timing Cover

When fitting the front timing cover make sure the felt washer which fits over the fan pulley is in good order; it is best to place the pulley in the front cover and refit them both together. When fitting this see that the thrust button at the end of the camshaft allows ·003 in. end float. This can be arranged with shims.

After fitting the front cover put up the sump. Test the position of the starting dog relative to the starting handle and compression before the engine goes into the chassis. Make sure the engine-bearer rubbers are in good order in the chassis.

The clutch should, of course, receive attention if necessary before assembling, and instructions for this have already appeared in an earlier part of this publication.

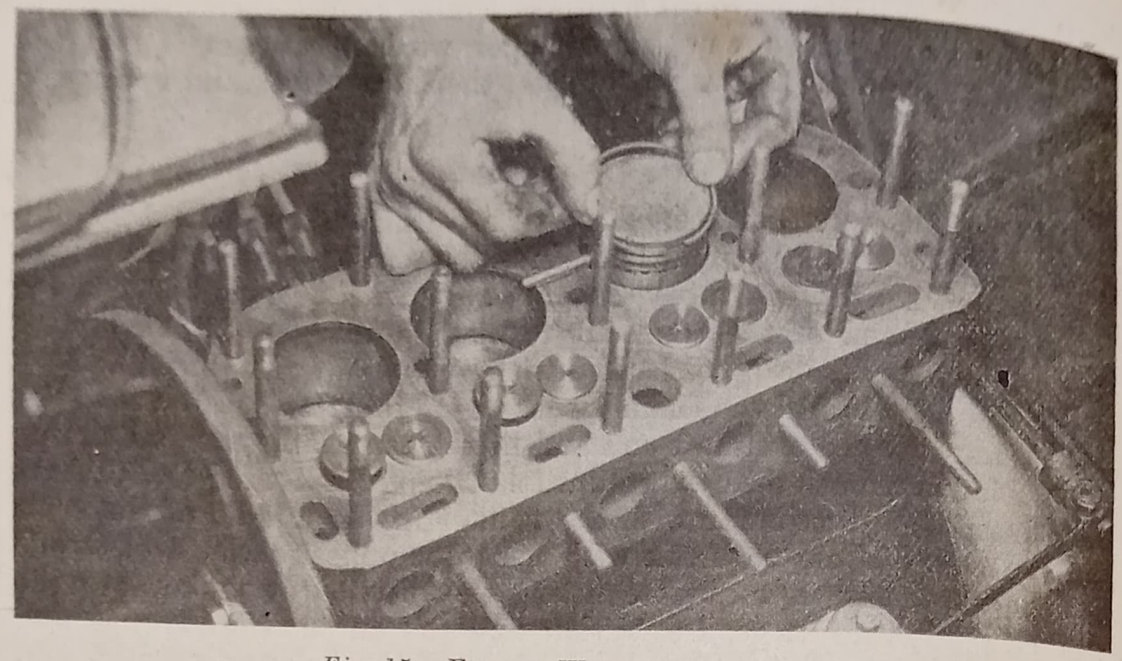

Fig. 15.—FITTING WELLWORTHY RINGS

This shows the tommy-bar through the gudgeon pin holding up the piston and connecting rod while the Wellworthy rings are finally fitted.

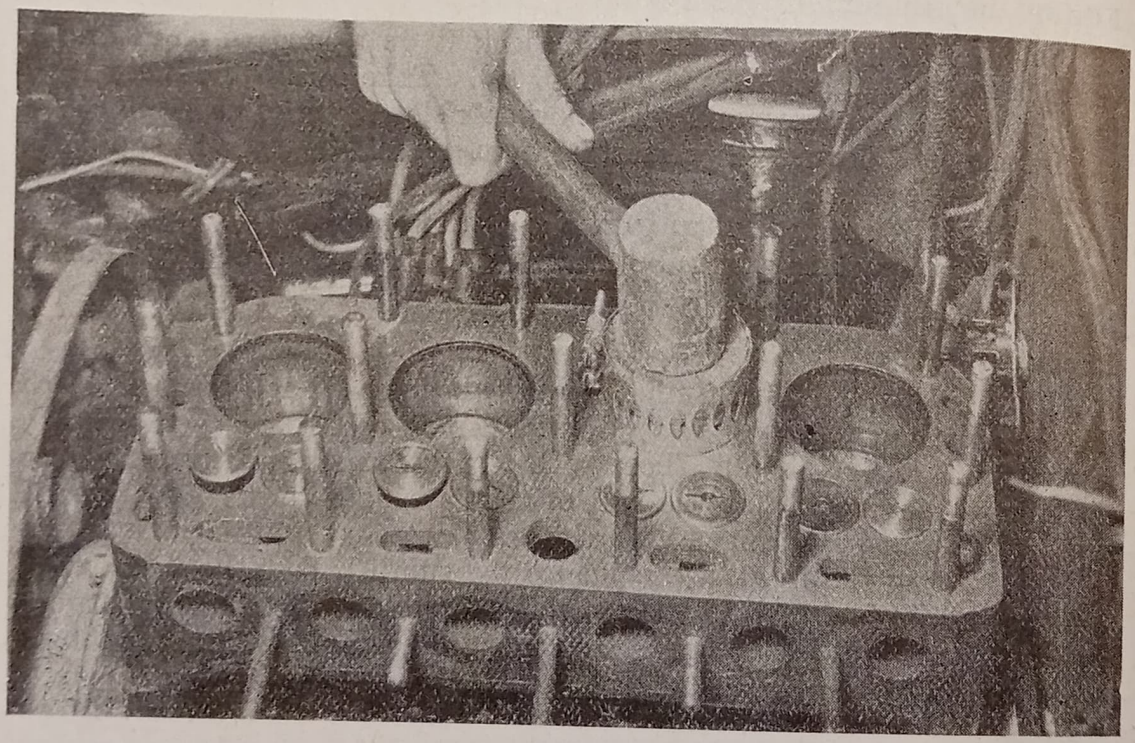

Fig. 16.—FITTING WELLWORTHY RINGS

Driving the piston fitted with Wellworthy rings out of the piston-cuff into the bore.

Running In

It is advisable to run the engine on a stand or test-bench if possible. If not, assemble the clutch and gearbox to the engine, refit it into the frame and mount up the starter, dynamo, petrol pump, exhaust manifold, distributor cap, sparking plugs, ignition wires, exhaust drop pipe, and controls. Do not adjust the dynamo belt too tightly or strain will be put on the armature bearings ; on the other hand, too slack a belt will cause vibration. Do not fit up the cardan shaft until the engine has been run in. The final tappet adjustment should be ·004 in. hot.

It is well to run the engine for the first 500 miles with colloidal graphite in the oil. Mix the compound with the engine oil before putting it in the engine, run the engine for about four hours, gradually increasing the revs. from about 800 to 1,500. At the end of that period it should be possible to give it a short burst of higher revs. If acting normally, keeping as free as can be expected and with no undue noises, the engine can be put into the chassis or coupled up to the propeller shaft if already in.

Reboring the Engine in Position

Assuming the test report has shown the main bearings to be in good condition, but the pistons and the big ends to need attention, it is not necessary for the engine to be removed. Take off the head and sump, then the oil rail. Remove the connecting rods and pistons from below and check the bores. Fig. 11 shows a Mercer bore gauge in use for this operation. If ·008 in. or more wear has taken place, rebore the block. This should not be done unless precaution is taken to collect all waste metal as it is cut from the bores.

Figs. 12 and 13 show a Van Norman reboring machine being used in conjunction with a Buma suction plant. By the use of machines such as these all the old objections to reboring in position are overcome, and the use of them with care and precision results in perfectly cut bores in the minimum of time. Bores can be cut as accurately as the operator can use his micrometer. It is always well, though, to cut to the middle grade of piston, namely 2. Then, if the human element enters into it and there is an error of half a thou. up or down, either a 1- or 3-grade piston can be used. It will be necessary, of course, to remove the valves and give them any attention as described previously. All the studs must be taken out, and for this use a stud box or chuck-type stud remover, and not footprints. Clean up the top of the block very carefully for assembling the boring bar. The radiator block must be removed and the two bottom nuts of the rear bearer. Place a jack under the flywheel housing and raise the engine as far as possible. It will not come up very much, but just enough for the bar to clear the standing dash. When the bores are finished refit the studs, having renewed any upon which the threads appear to have stretched.

Before fitting the connecting rods and pistons renew any bearings necessary, check the gudgeon pins, and line up the pistons.

Fitting Wellworthy Piston Rings

If the bore is found to be worn not more than ·008 in., Wellworthy piston rings should be fitted. New compression and oil-scraper rings should, of course, be used at the same time. Under the conditions mentioned, Wellworthy rings are an infallible cure if fitted correctly. The instructions for machining the pistons and fitting the rings must be closely followed. The depth and width of the groove are most important. The drilling of the two relief holes in the bottom of the grooves on each piston must not be forgotten.

It is necessary to remove the ridge at the top of the bores. A scraper can be used for this but it is a slow method, a section might be missed. It is better to use a ridge-removing tool, as shown in Fig. 14.

Fitting the Pistons

The rings having been fitted they should be removed from the pistons and each, with the connecting rod fitted, should be passed into the engine from below between the crankshaft and crankcase on the opposite side to the camshaft. Pass it right through until the gudgeon pin is clear of the top of the block; pass a small bar through the bore of the gudgeon pin. This bar should be long enough to prevent the piston dropping back through the cylinder block (Fig. 15). Now the rings should be fitted. Here again the instructions supplied with the rings should be exactly followed. The position of the slot relative to the gudgeon pin is important. For inserting the piston a special cuff supplied by the makers should be used. When the cuff is fitted the piston should be given a smart blow with a lead or hide hammer to drive it into the bore (Fig. 16).