

Norton Atlas engine overhaul

Part one: stripdown on the Dominator/Atlas/Commando twin cylinder engine with Norton expert Mick Hemmings.

Report: Brian Crichton. Pictures: Rod Sloane.

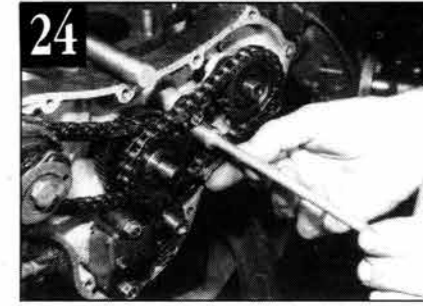
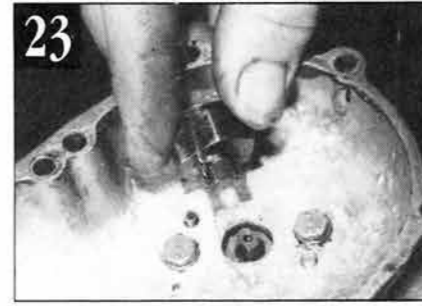
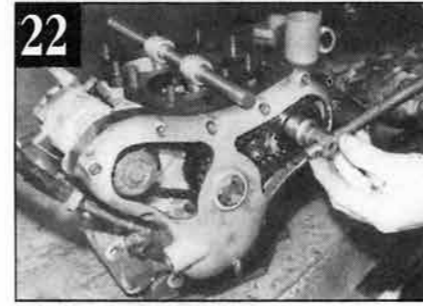
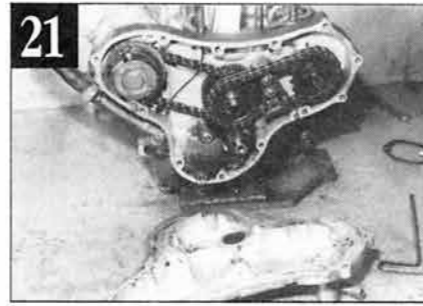
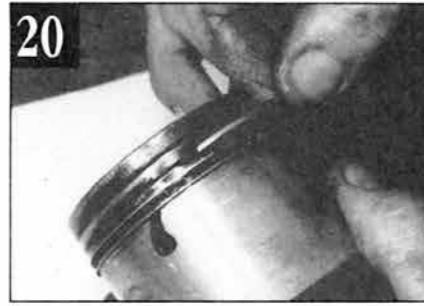
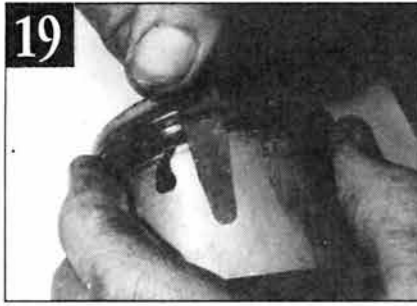
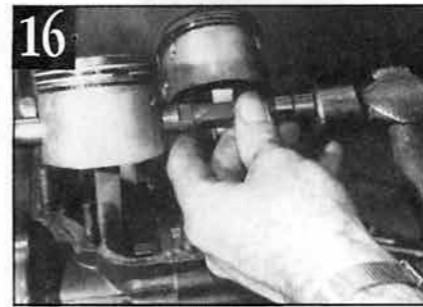
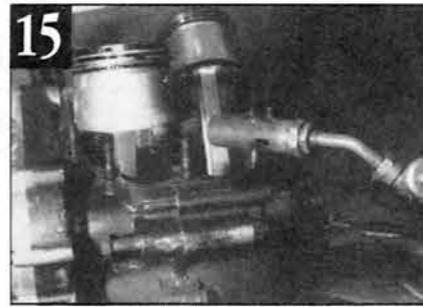
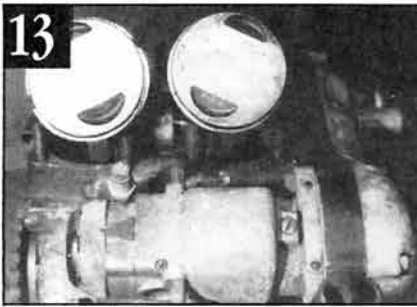
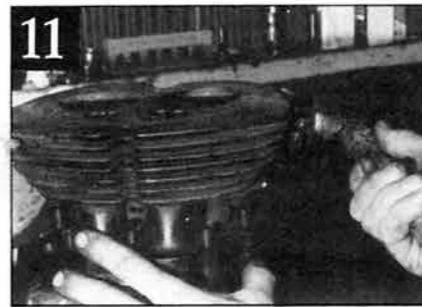
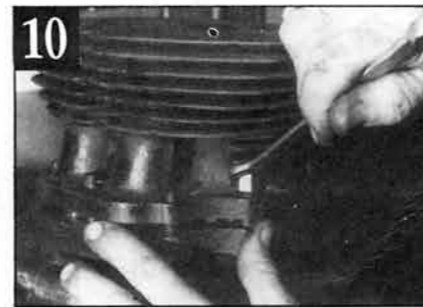
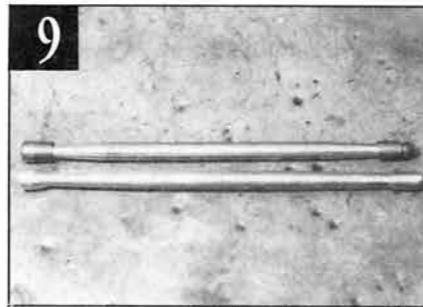
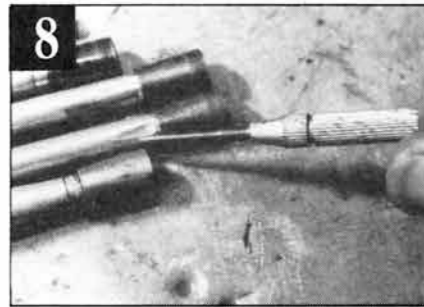
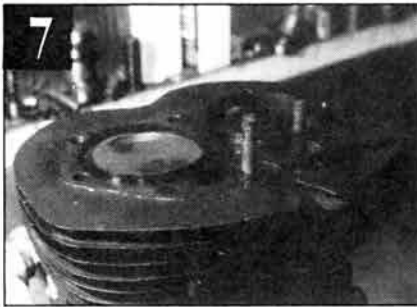
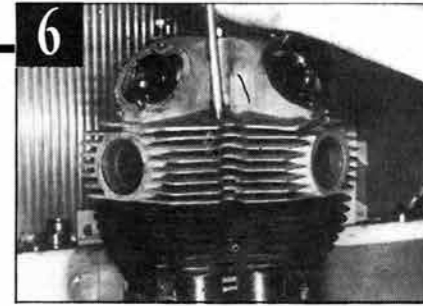
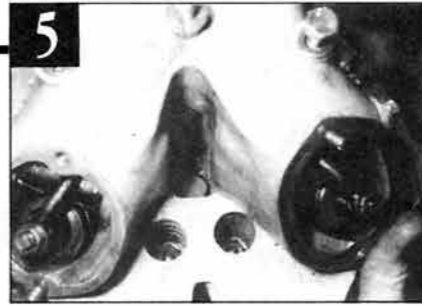
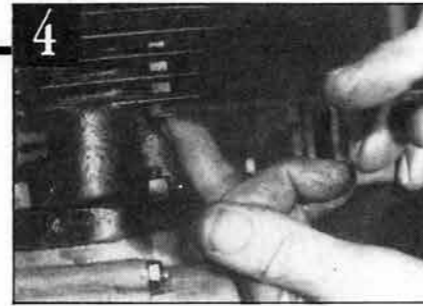
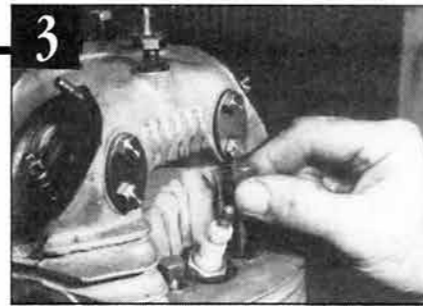
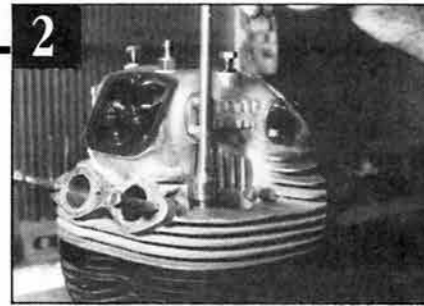
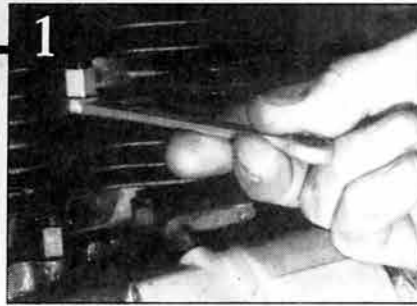


THE following stripdown applies to the Norton 88, 99, 650, 750 and 850cc models. Where difference in parts and procedures occur, these are mentioned in the text.

Start by making sure your working area is clean and clear, that you have a good selection of quality tools (types are mentioned as we go along) and two trays, one for components from the left side of the engine, the other for the right.

Life will be much easier if you make up an engine stand if you don't already have one. The engine being worked on in the pictures is from a 1968 Atlas and the cylinder head from a 650SS.

- Start by removing the spark plugs.
- Remove rocker covers – $\frac{3}{16}$ Whitworth spanner for the exhaust, $\frac{3}{16}$ for the inlet.
- Slacken off the valve clearance adjuster locknuts ($\frac{3}{16}$ Whit).
- Note that Whitworth spanners and sockets are required throughout for working on the twins dealt with in this story, though as a point of interest some threads used on the Commando engine are AF.
- To remove the nut at rear of cylinder head (pic 1) use $\frac{1}{4}$ Whit flat ring spanner. Space is very tight, so unless the spanner is unusually 'thin' it will have to be ground down for clearance. (Remember that the cylinder head being worked on in these pictures is from a 650 SS model.)
- Loosen the four outside head bolts ($\frac{1}{4}$ Whit) slackening a bit at a time in criss-cross pattern to even the torque on the head (pic 2).



- To take the head bolts right out you may have to remove the rocker spindle end caps if they get in the way (pic 3).
- Note that there are flat washers under the four head bolts, but there is NO washer under the rear nut. There are two 1/4 Whit sleeve nuts on each barrel. Remove these four sleeve nuts, (pic 4) noting that there are no washers. The spares list for the Mk3 Commando shows washers, but this is incorrect.
- Remove the two head retaining nuts and washers at the front of the engine (pic 5).
- The centre bolt (with washer) which can be seen in pic 5, can now be slackened using socket or T-bar (pic 6). As the bolt is being undone the head will lift under tension from valve overlap. Valve adjustment was earlier made slack to ease this tension.
- The cylinder head and gasket can now be lifted off.
- When working on a Commando with the engine still in the frame you have to tip the head 'backwards' and lift the pushrods into the head so that head and pushrods are removed together. There is no problem with clearance on pre-

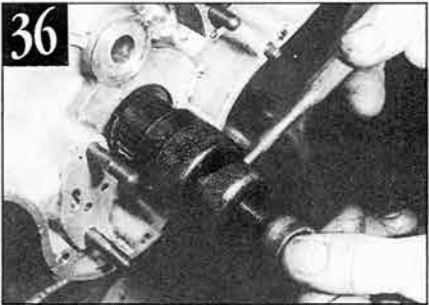
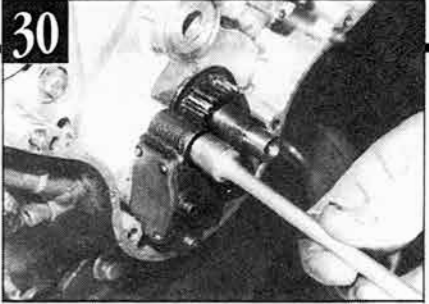
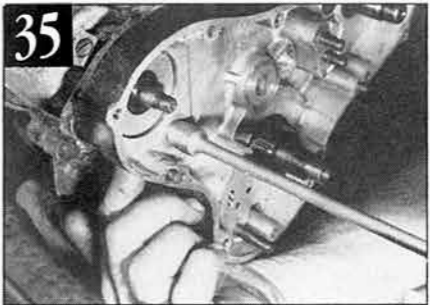
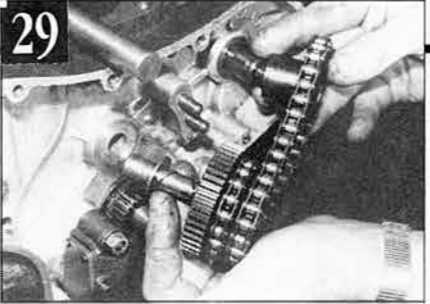
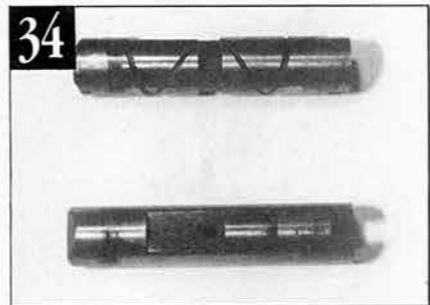
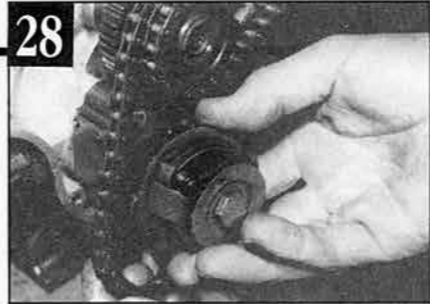
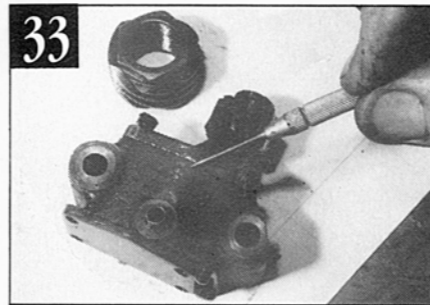
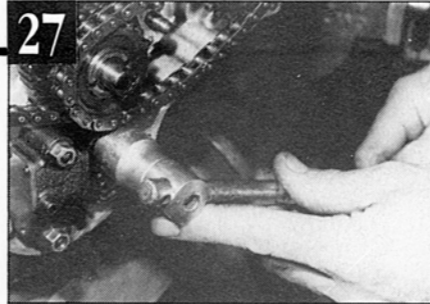
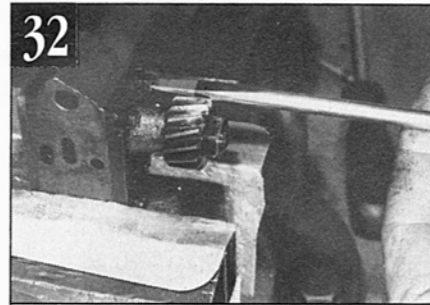
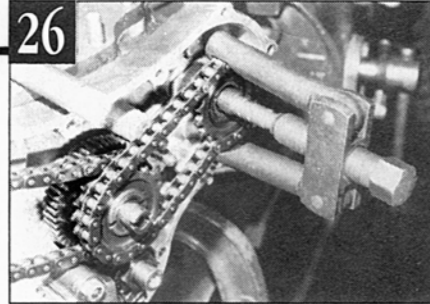
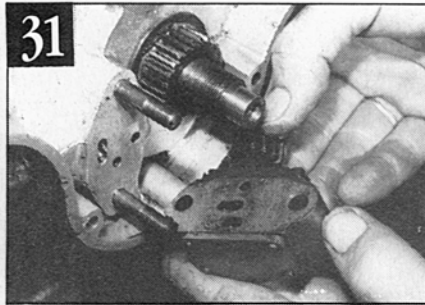
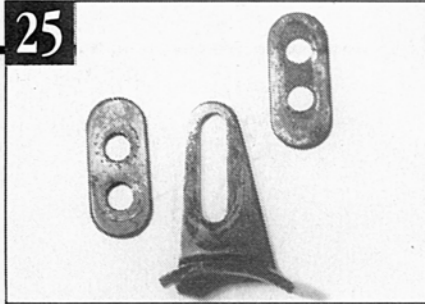
- Commando models.
- Mick can supply solid copper head gaskets to replace the less effective copper asbestos types usually fitted to 88, 99 and 650 models.
- Early engines have a lip (spigot) where the liner is above the level of the barrels (pic 7). This spigot helps to give a good combustion chamber seal. On engines with maximum overbore the weakened spigots tend to break.
- If spigots are in good order they are best left. If broken they should be machined down flush with the barrel tops.
- Remove pushrods and inspect. The two longer rods are inlet and the short pair exhaust. This engine had been fitted with a mixture of early straight rods and later barrel shaped rods.
- Check rods for damage (pic 8) and loose ends. If either is evident throw the rod away. Mick recommends the barrel type rod because it is more rigid, and it is this type he uses in his racing engines, preferring them to the one-piece alloy racing type (pic 9) and alloy cap type.
- It is worth mentioning here that early engines have 3/16in bolts holding the head and later 1/8in. The three studs on the

- cylinder head are 26 TPI (threads per inch) on all models.
- Bore x stroke of the 497cc Dominator 88 is 66 x 72.6mm; 598cc Dominator 99 68 x 82mm; Dominator 650 (646cc) 68 x 89mm; 745 Atlas and Commando 73 x 89mm; and 828cc Commando 850 77 x 89mm.
- Barrels from the 598cc Dominator 99 can be used on 650 engines, but 750 and 850 barrels will not fit 650 Dominator crankcases. The 500 is not interchangeable.
- Note that pictures from now on are of an early Atlas engine.
- Base nuts on early models are 3/16 Whit, and on later models including Commando, 1/4 Whit except the front two which are 3/16 Whit, all with flat washers (pic 10).
- If the barrels are stuck, a tap with a soft hammer from the side (pic 11) should free them. Do not hit a barrel from underneath or you are likely to break a fin.
- Lift the barrels slightly to remove the rear base nuts. On this engine there are seven 3/8in and two 1/2in base nuts all with flat washers. Threads are 26 per inch except Commando which uses UNF

- pattern.
- Early pistons and some Commando have split skirts (pic 12). Mick does not recommend this type for high speed work because, he says, the tops can come off.
- On the engine pictured, the rings had seized in, partly due to the fact it had been standing for many years (seven at least) and probably because of condensation caused short journey use.
- In this instance the pistons looked to be in good order and it was noted that the later and stronger rods had been fitted.
- Note that valve pockets in the piston crowns are offset (pic 13) because the pistons are 'handed', ie they are not interchangeable.
- Place a rag in the crankcase mouth before removing piston circlips to prevent circlips falling in crankcase.
- Use proper circlip pliers to remove the circlips (pic 14). Never use the circlips again. Always fit new.
- Instead of new circlips PTFE buttons could be fitted.
- To remove gudgeon pins carefully, heat pistons by using camping gas hand held heater (pic 15) or similar.
- Use a suitable drift to tap out the gud-

- geon pin (pic 16) while supporting rod and piston. Note that Dominator engines, have small end bushes, whereas 650 SS, 750 and 850 engines do not. The later plain bearing type small end never wears.
- Check cam followers. Pic 17 shows a wear groove indicating that these followers should be renewed. The grooves will wear the cam lobes.
- Note that earlier engines have radiused cam followers, whereas later types are flat (pic 18). This engine was fitted with flat followers which are correct for the year.
- Plus 40 thou pistons were fitted to this engine. Maximum oversize is plus 60 thou using Hepolite pistons "if you can get them" remarks Mick.
- Use feeler gauge to slide rings off piston (pic 19), being careful not to break the brittle cast iron rings.
- Use old broken piston ring to clean out ring grooves in the piston (pic 20).
- Before throwing away old rings, make sure you can obtain new ones.
- Remove timing cover (pic 21). Cheese head screws are fitted standard. On this engine the previous owner had fitted Allen screws - "a good idea" commented our Norton expert.

- The timing cover sports 12 screws of varying lengths. Making up a cardboard template to house the screws in proper order will help speed the rebuild.
- Note that there should be a gasket on the timing cover.
- With the cover removed note that the chain driving the magneto (pic 21) is thinner than the chain driving camshaft.
- To support the intermediate gear shaft when loosening the camshaft nut, Mick has a cutaway timing cover. A spare cover costs a few bob from the autojumbles these days - that's if you can get one - but Mick regards it as essential to do the job properly (pic 22). Without it you are likely to stress the intermediate gear spindle which can then cause excessive housing wear.
- Note in pic 22 that the crankshaft has been locked by passing a metal bar through the small ends of the conrods. Use a piece of wood under the metal bar to prevent it from damaging crankcase top. Mick has a special plate for this purpose.
- Undo cam nut (1/2in Whit). Note that slotted peg on this nut drives the rev counter (pic 23). As a note of caution,



Mick recommends 7000rpm as the maximum for this engine – after we've rebuilt it, of course.

- To release the magneto, the nut ($\frac{3}{16}$ in Whit) will slacken and then tighten as it self extracts. The auto advance unit pictured is very difficult to get hold of nowadays.

- The cutaway timing cover can now be removed.

- Slacken the cam chain tensioning slipper (two nuts $\frac{3}{16}$ Whit pic 24).

- The slipper can wear out, but it doesn't usually break. Note position of slipper and plates (pic 25). The thin plate (right) goes behind the slipper with long part pointing down. The thick plate goes on the outside, its long part pointing up. By 'long part', the longer distance from bolt hole to outer edge of plate is referred to. This is most clearly seen on the thick plate to the left of the slipper.

- Usually the cam sprocket can be removed by hand, but if tight a sprocket puller will be required (pic 26) to loosen it.

- Remove oil pump drive gear ($\frac{1}{2}$ in Whit) noting that it is left-hand thread (pic 27).

- Remove auto advance unit and spindle (pic 28).

- Cam sprocket and intermediate gear spindle, which is loose, can now be removed (pic 29). Note that behind the gear is a hardened steel washer. This is fitted to all engines except Commando after engine no 131257.

- Remove oil pump (two $\frac{3}{16}$ Whit nuts). The oil pump (pic 30) gears can wear inside. When this happens, oil will drain from tank to sump via the pump. Mk3 Commando engines have a valve and spring in the timing cover to prevent this happening, but this doesn't always do the job, reports Mick, who recommends a straight 40 mineral oil in these engines such as Castrol 351 or Shell SR. For racing engines he recommends Castrol R.

- It was noted that a conical rubber off the pump was missing. This will be dealt with on rebuild.

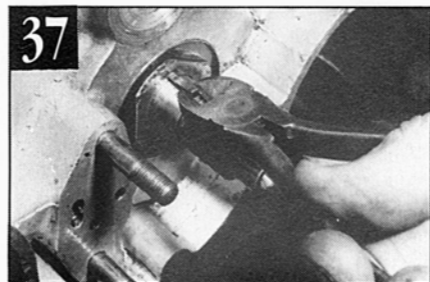
- No oil pump gasket is fitted to this engine (pic 31), but a gasket is fitted on late Commando engines.

- Check pump for end float and gear wear. In this case there was no problem

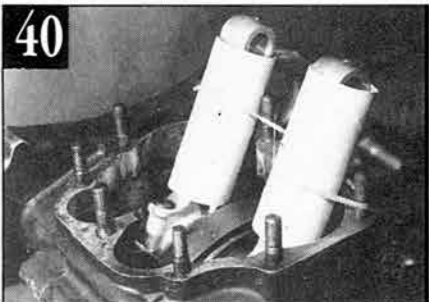
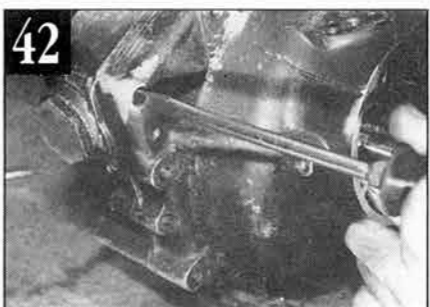
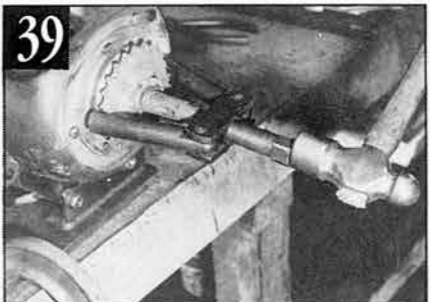
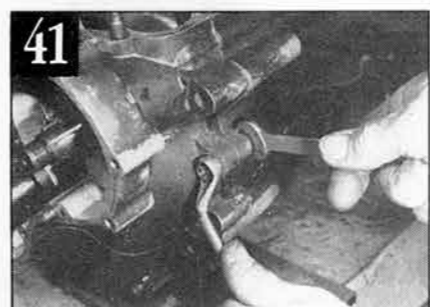
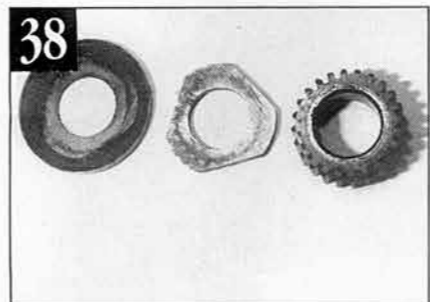
with float, but there was wear on the gear. Commando pump has larger gears.

- Undo the four screws holding the pump (pic 32). The letter S stamped on the pump denotes (pic 33) that it is the later Dominator pump. This is one of the 'six start' drive gear pumps which runs faster than previous types and so improves oiling.

- A favourite modification of years gone by to improve Dominators with three start pumps was to fit the later six start gears from an Atlas or Commando. However, there was a drawback. The improved flow would feed too much oil to the rocker boxes via the Dominator's rocker



spindles with spiral grooves. To prevent this the plain spindles from later Atlas and Commando models should be fitted. Both spindle types are shown in pic 34.



The Norton Dominator twin engine from which the Atlas was developed

- Note that if modifying a three start pump to six start you must change both mating gears.

- Remove oil unions from engine. These run parallel, feed to the outside.

- Remove magneto: $\frac{3}{16}$ Whit top two nuts, the bottom being a nut and bolt (pic 35).

- If the magneto requires reconditioning this should be carried out by a specialist. Cost is about £100, reports Mick. Pictures show a later type magneto, by the way.

- A special tool is required to extract the crankshaft pinion (pic 36).

- Remove Woodruff key from shaft using pliers or sidecutters (pic 37).

- Remove triangular spacer and shield (shown in pic 38 with pinion). The shield prevents swarf getting to the main bearings.

- If main bearings are to be replaced, Mick recommends Superblend, a barrel shaped roller which prevents the edges of the bearings digging in when the crankshaft whips.

- Superblend bearings are not cheap, but Mick assures us that buying bearings from dealers can be a lot cheaper than going to a bearing specialist. Check out the prices to decide for yourself.

- Removing the engine sprocket will need a puller (pic 39) and may require heat to the sprocket as well. Hit the puller as shown to help shock the sprocket free. Use a steel hammer for this job.

- Note that the sprocket is located by a Woodruff key.

- It is a good idea to protect conrods while the engine is being worked on by wrapping them in some sort of protective coating. Pic 40 shows that toilet roll cardboard can be put to good use in this respect.

- Work can now begin on separating the crankcase halves. Systematically loosen all nuts holding the halves together. These are various sizes. For example, tools being used in pic 41 are $\frac{3}{16}$ Whit ring and $\frac{1}{4}$ Whit open ended.

- In addition there are two screws holding the halves together, one shown in pic 42.

- With all securing nuts and bolts undone, part the crankcases using a hide mallet as shown in pic 43. Never hit the end of the crankshaft in an attempt to separate the cases.

- An oil seal was missing from this engine. This will be covered in the forth-

coming rebuild story.

- Remove breather and spring (pic 44). The breather turns with the cam on Dominator and early Commando models and is thus 'timed'.

- The camshaft simply pulls out (pic 45).

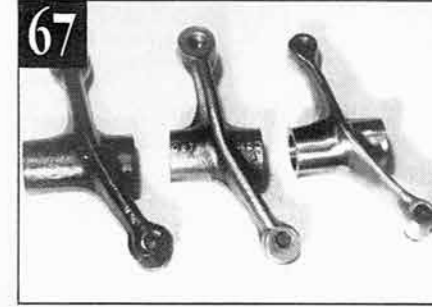
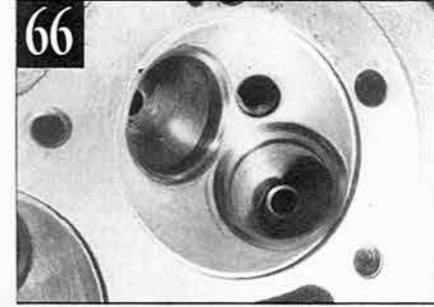
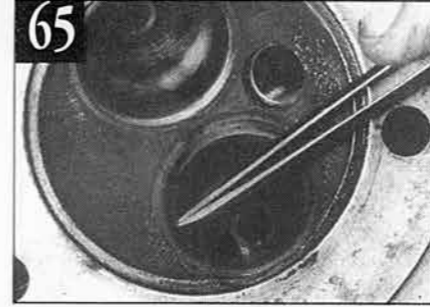
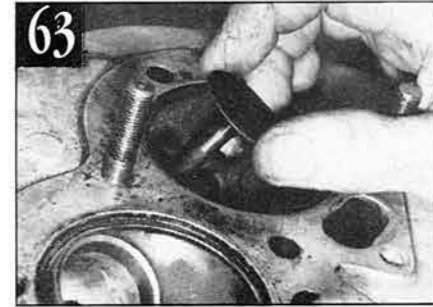
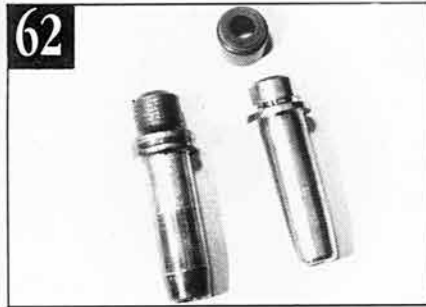
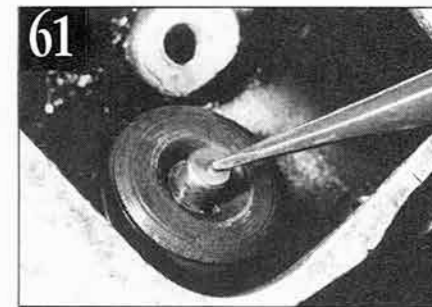
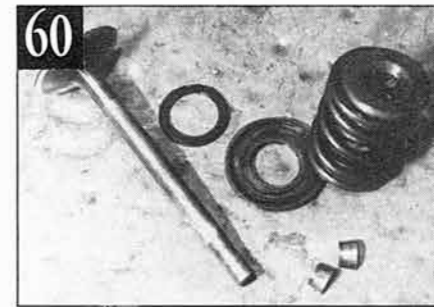
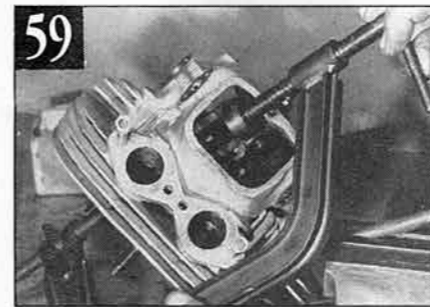
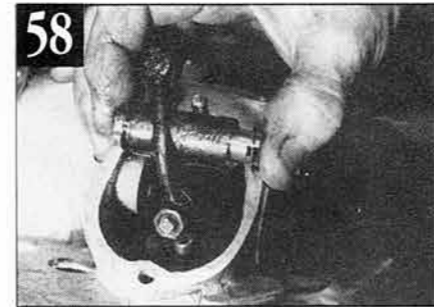
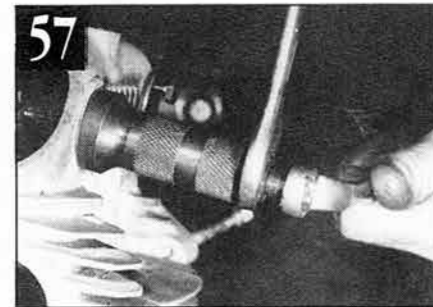
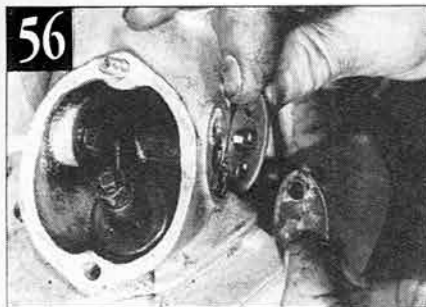
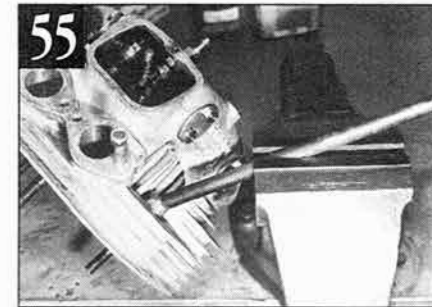
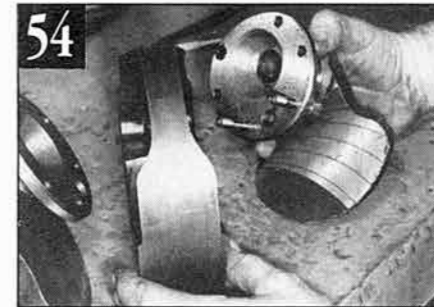
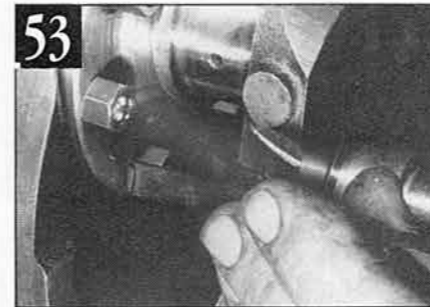
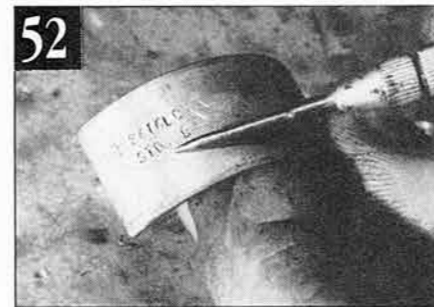
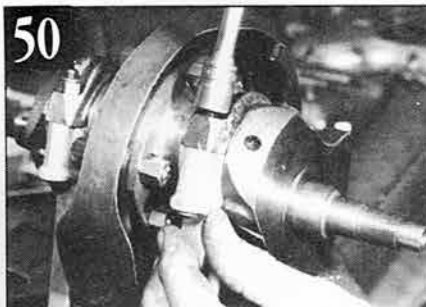
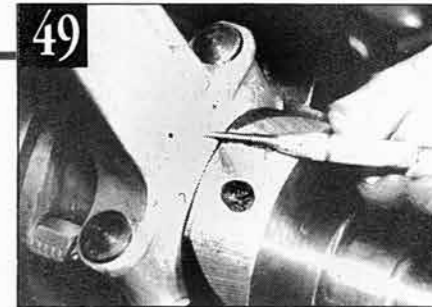
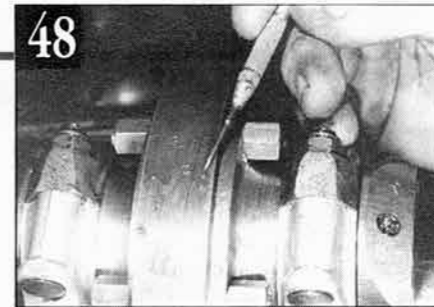
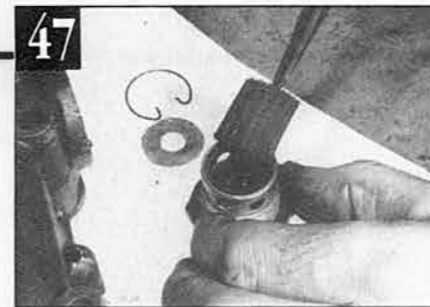
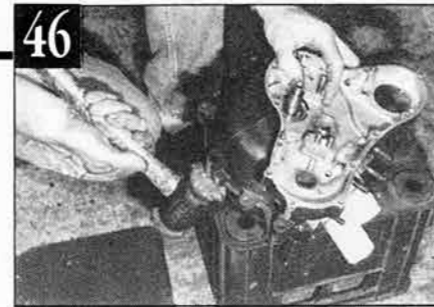
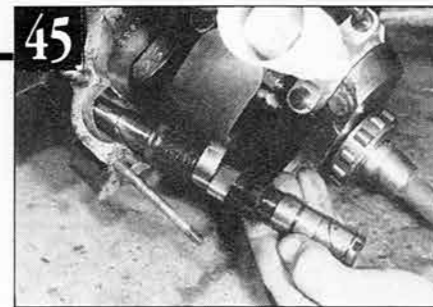
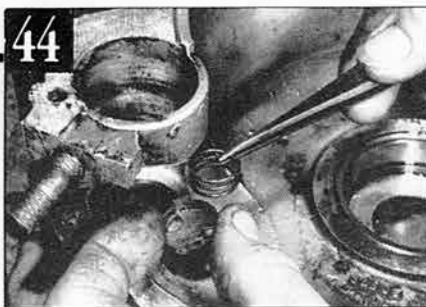
- Tap the other crankcase half off the crankshaft with caution, resting the crank on a beer crate or similar (pic 46).

- If necessary warm the case and lift it off the main bearing, leaving the bearing on the crank. Then use a puller to get the bearing off the crankshaft.

- The crankshaft in this engine was from a Commando and had been fitted with new main bearings of the usual (ie not Superblend) type.

- Remove the sump plug, remove circlip and clean the gauze filter (pic 47).

- The 06 part number (pic 48) and rounded bosses indicate that this is a Commando rather than Dominator/Atlas crank. Concluding evidence was an 850 stamp. This crank in standard form is balanced to 55 per cent which is fine for the Isolastic Commando frame, but too low a balance factor for the rigid framed Featherbed Atlas from which this engine came.



- To assist correct re-assembly score the flywheel and bolt-on boss so that they will be fitted the correct way round.
- Later conrods (from engine 116372), as shown in pic 49, have oil spray holes for the bores. The holes go to the 'outside'.
- Remove conrod cap using 1/4 Whit socket (pic 50). When rebuilding always use new bolts and nuts.
- Remove the plain shell big-end bearing (pic 51). The size of the shell will be printed on the back of the shell (pic 52). In this case it was standard (STD).
- Big-end diameter on 650SS, Atlas and all Commando models is 1.750in. Dominator 88 and 99 models are 1.500in.
- Note that crank assemblies other than 850 Commando are put together using nuts and bolts, the 850 having studs and nuts.
- Note that the crank pictured is made up with studs and nuts which are the only Norton parts now available for crank rebuilds and are suitable for all models.
- To dismantle this crank 1/2in AF tools are necessary because it is a Commando type. Earlier types require 1/4 Whit.
- Note that there are lock plates on the bottom two studs (pic 53).
- Mk3 Commando engines have UNF

studs and nuts instead of 1/16 Whit as on earlier models, and the 850 Mk3 has an extra stud instead of a dowel to locate the two bosses (checks) (pic 54).

- The flywheel sludge trap should be thoroughly cleaned using paraffin or petrol.

If you've made it this far, stop to have a cup of tea and clear up the tools ready for the next attack. While sipping the brew consider the Hemmings' doctrine on evolution... "On the seventh day God made Norton, and after that he made the GP carb... Did you bear the one about the two gamekeepers...?"

The tea break is recommended by Mick when a problem is encountered. If you've tried various approaches and none have worked, then it's time for a break to consider the matter. Starting afresh usually comes up with a solution that works.

"Never force anything," advises Mick. "Just use a bigger hammer. Seriously though, if it won't come off there's a reason."

Tea break humour over with, let's move on to dismantling the cylinder

head components.

- Recommended spark plugs are N3 Champion. If you want a softer plug for short journey and town use, Mick recommends an N4. Do not use projected nose N9Y or N6Y plugs. These were developed for car engines and are not suitable for Nortons, advises our Norton mentor.
- The picture sequence now reverts back to working on an early 650 SS head.
- Working on the head is made easier by using a tool threaded into spark plug hole and gripped in the jaws of a vice as shown in pic 55. But beware of putting too much pressure on the head.
- Remove rocker spindle outer caps (pic 56). These are two-piece, the inner having a peg to hold the spindle.
- A special tool extractor is required to withdraw the spindles (pic 57). If spindles are very tight in the head, then the head will require warming up to expand it.
- This head had been fitted with plain spindles and not the usual spiral groove type.
- On the outer side of the rocker, the spindle carries a thrust washer and on the inner side, a double spring (Thackeray) washer to control end float (pic 58).

- On his racing engines Mick uses a bronze bush in place of the Thackeray washer to assist more accurate control of valve opening.
- Rocker spindles are interchangeable.
- To remove stud on the inlet rocker cover you need to use two nuts locked together.
- With the rocker gear removed, remove valve springs using valve spring compressor tool, and remove split collets.
- Note that under the collar in which the valve inner and outer springs sit there is a 'heat' washer. This is shown in pic 60.
- If you want to uprate your engine to race spec, and are fitting a race cam, Mick advises leaving this washer out.
- Mick deemed the valves in this engine to be scrap because they had worn through the hardening on their tips (pic 61).
- Note that Commando inlet valve guides are fitted with rubber stem seals. These are fitted because the engine is inclined forwards. They reduce the amount of oil that can pass along the valve stem and into the combustion chamber. Both types shown in pic 62.
- When replacing valve guides, Mick

recommends alloy bronze type only. "We never fit cast iron guides, because if the motor has done a lot of mileage they can shatter, but a bronze guide will never break."

- Check valve-to-guide play by rocking the valve in the guide (pic 63). The valve should be a nice smooth sliding fit with minimum sideways movement.
- In addition it is recommended that you measure the diameter of the valve stem and check it against a new one. Also be aware that some new valves are on the small side, so it is worth checking as many as you can. Valve sizes will be further dealt with on rebuild.
- To remove valve guides for renewal, heat the head in an oven and then use the special valve guide drift to tap out the old valve guide (pic 64).
- When oversize guides are needed, as in this case, declared our Norton lynch pin, the head should be professionally bored to accept the larger guides.
- Inspect cast valve seats for 'pocketing'. The valve head should be flush with the combustion chamber and not sunken in due to excessive wear.
- Also check the valve seat for pitting

(pic 65). If the seat is in fair order it can simply be reground. If damaged or pocketed, a new insert will be required. Pic 66 shows a head with new inserts, the inlet being an alloy bronze type. The head is from a 500cc model.

- Note that there are two widths of rocker. The widest on the left in pic 67 is a 1 1/2in from an early engine. The later type (centre) is 1 3/4in. Shown right is a polished racing type 1 3/2in. All feature an oil hole fed through the hole in the rocker spindle to stop the pushrod ball wearing.
- Now it's time to take our leave as Mick prepares his Nortons for their next races. Data and engine rebuild sequence on the mighty Atlas will be covered in the next issue if all goes well with the editorial master plan.

FOR all your Norton requirements including new Norvil racers contact Mick Hemmings Motorcycles, 36-42 Wellington Street, Northampton. Tel: 0604-38505.