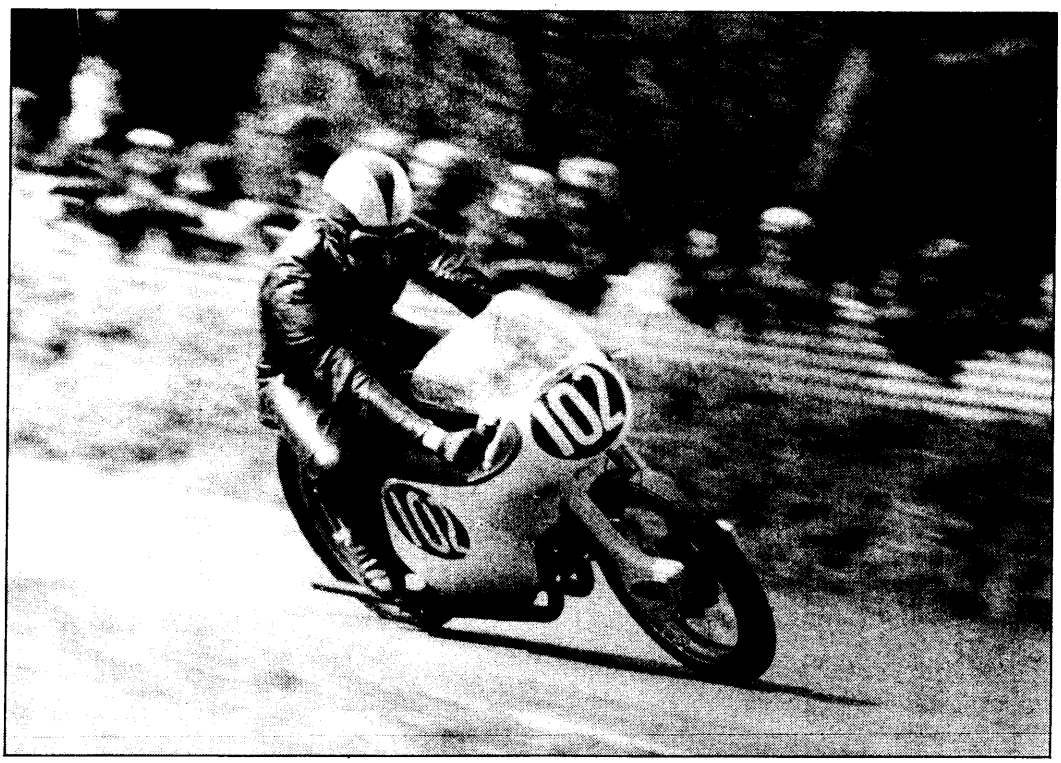
1989-04



MAKING THE *ARROW* *fly*

WITH BARRY HICKMOTT

"ARIEL ARROW CAPTURES WORLD 250 road race crown!" What a headline that would have made – it never happened, of course, because success of that kind was never given any serious consideration by the management at Selly Oak. But, had the lads on the shop floor had their way, a banner headline like the one above might not have been so remote a possibility, after all.

Let's just put this two-stroke design into its proper context. Now, unless you've been holed up in a cloister for the past few decades, you'll have heard of this little Japanese company called Yamaha who, like Ariel, started developing a 250cc two-stroke twin back in 1956. As was the practice in post-war Japan, Yamaha selected several western models to study and emulate. Probably the best known of these was the DKW RT125 (which in BSA's hands became the Bantam and in Yamaha's, the YA1), but attention soon turned to the 250cc category and, like Ariel, the Japanese manufacturers looked to the German-built 250 Adler for inspiration.

Just consider the following specification: 250cc, 54mm by 54mm bore and stroke, 180-degree crankshaft, two-stroke twin-cylinder, deep spigotted cast-iron cylinders with single carburettor bolted to the crankcases, four-speed gearbox, pressed-steel frame with underslung engine and small, drum-braked 325 x 16in wheels. Sounds rather like the Ariel Leader, doesn't it? It is, in fact, the basic spec for a 1957 Yamaha YD1, a 20bhp racing version of which won the Mount Asama race in the same year, establishing the two-stroke twin as Yamaha's special forte over other Japanese makes. Thirty years later, Yamaha are still producing popular two-stroke twins while Ariel is just another entry in the history books, a name that died when production of the Leader and Arrow ceased in 1965.

It's that tired old story again, I'm afraid: the top brass thought new tooling and extra money to finance development work were unnecessary and that trials and scrambling success was enough to sell machinery across the range. It was left to the Japanese to make the connection between volume road machine sales and good performances on the road-racing circuit, a policy pursued by them with enormous enthusiasm.

Ariel had, in fact, been given a good indication of the Arrow's racing potential when, in 1960, Michael O'Rourke gained seventh place in the Isle of Man TT with a race speed of 80.18mph. This was no exotic factory-bred machine but a simple conversion carried out by the well-known two-stroke engineer, Hermann Meier, using parts bought at discount from (bless 'em) the factory at Selly Oak.

The essence of Meier's work involved converting the engine to twin Amal GP carburettors which were fitted to a plate bolted on to the crankcase. (The actual fixing of the carbs was

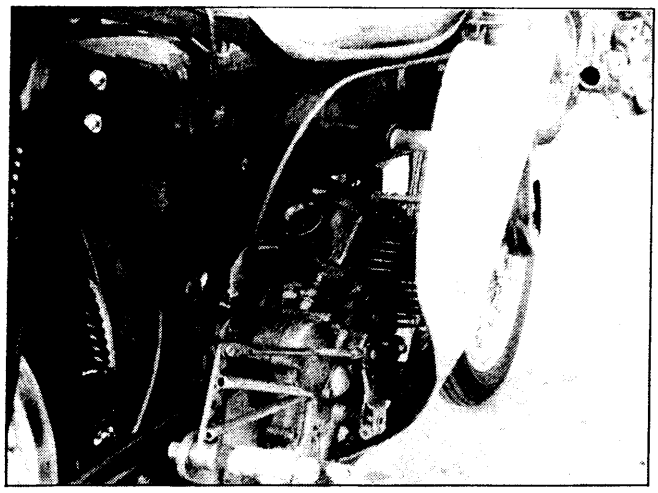
the most problematical part of the whole operation.) The rest of the machine was standard Arrow with the road gear removed, expansion boxes added and the wheels rebuilt into 18 inch rims.

So what did Meier's conversion prove? Well, for one thing it demonstrated that in order to achieve a lap average of 80.18mph, the engine must have been producing between 30 and 32 brake horsepower. Just think, then, how simple it would have been for the manufacturers to produce a production racer or, at the very least, a race kit based on Meier's ideas! (An example of just what could be done was the evil-handling and less reliable 35bhp TD1A racer produced by Yamaha in 1965 – a full five years later.)

But even if the management was unable to appreciate its potential, there were others who did and several Arrow-based projects blossomed during the early to mid Sixties. For a start, the lads in the design office and on the factory floor were eager to take up the challenge, producing a number of special parts which gave the Arrow a 100mph plus performance. Take, as an illustration of this, the machine entered by Peter Inchley for the 500-miler.

Roger Barlow, of the Ariel design office, remembers well the tricks they got up to. A favourite one was to bore the carburettor so that the number on the body identified it as a standard item; in reality, of course, it was a much larger component. As standard machines go, then, Inchley's Arrow was about as straight as a nine bob note, a fact which was amply demonstrated when Peter lapped the MIRA (Motor Industry Research Association) track at a consistent 97mph! To give the factory its due, this was only what you might call a semi-official entry, but Peter's race budget wouldn't have bought him a packet of fags.

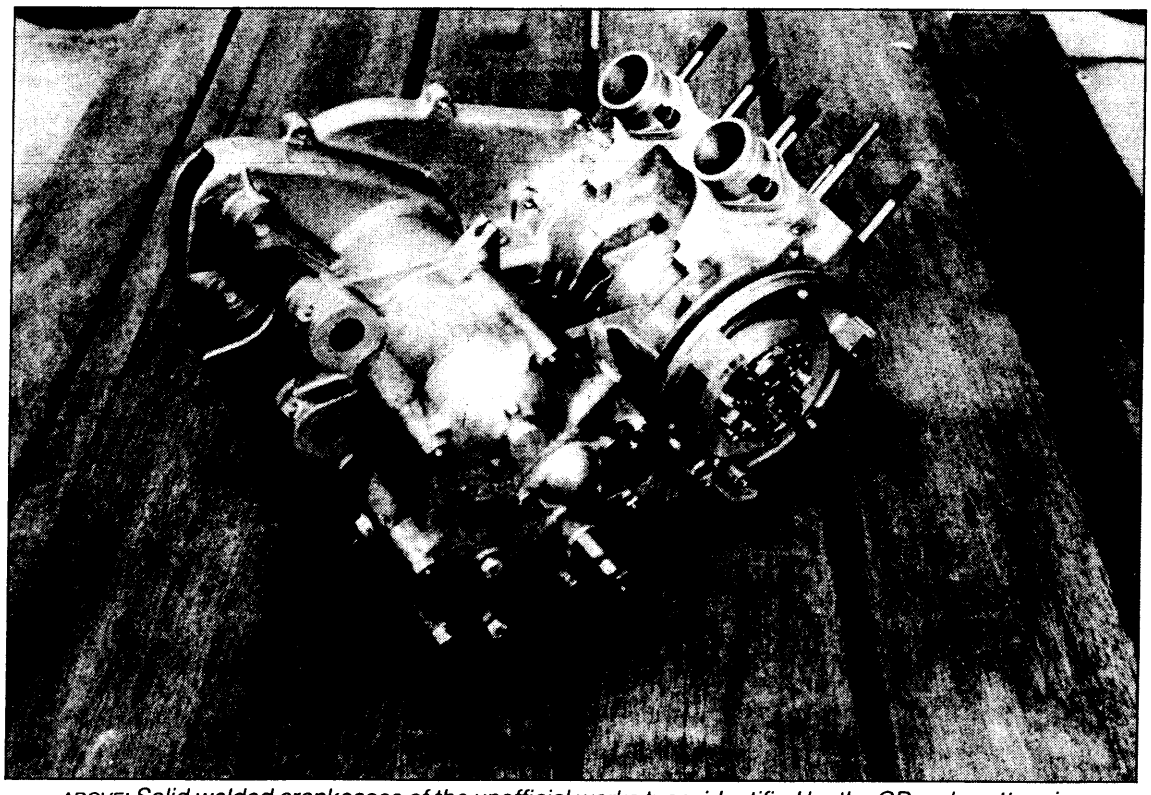
All manner of goodies were manufactured in dim, dark corners of the factory: twin carb crankcases, alloy cylinders, even special crankshafts – supplied by Alpha Bearings – and several sets of close-ratio gear clusters were tried.



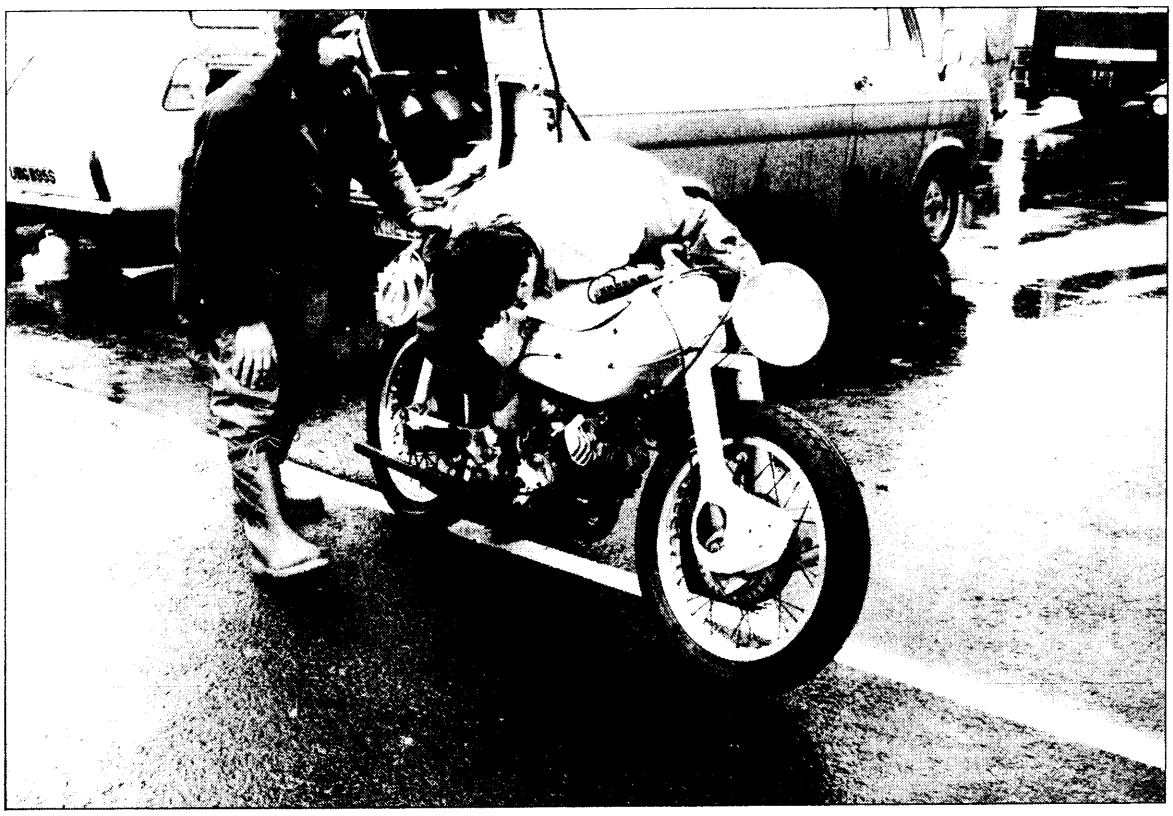
An Ariel Arrow converted to twin carb set-up using aluminium blocks screwed to the crankcases.

The early Sixties was a particularly interesting period for road racing, an era of invention for competitors in the 250 category as only top riders, or those with plenty of money, could afford to run a works or ex-works racer. There was very little in the way of production race machinery, a fact which was amply demonstrated by Greeves when they modified a Villiers engine and found instant success with the simplest of conversions.

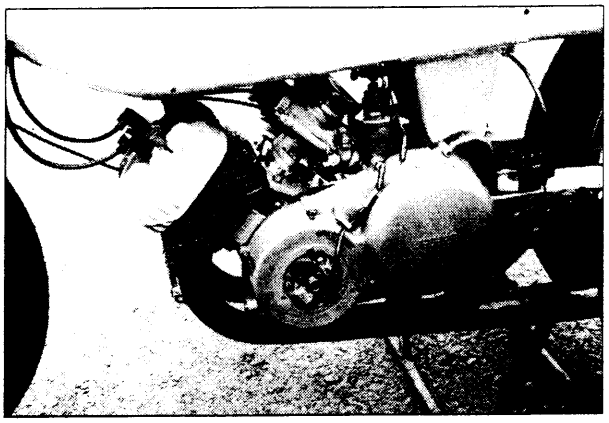
But what could the Joe Averages of this world expect to race? What could they afford? Cut-down Velos and twenty-year-old Rudges, Villiers specials even, most machinery had to be engineered and modified in a big way, so it was only natural that more and more people should turn to the humble Ariel Arrow. Hermann Meier had not kept his porting a secret – 185° exhaust, 135° transfer and 180° inlet – so with an



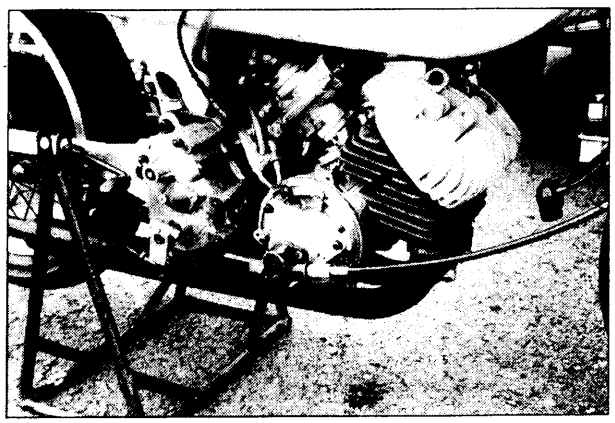
ABOVE: Solid welded crankcases of the unofficial works type, identified by the GP carburettor size flanges; OPPOSITE PAGES: Peter Inchley riding his unofficial factory Arrow at Mallory Park.



This early Sixties converted machine has been fitted with 18in wheels, NSU Max front brake and fibre-glass seat and tank.



The standard Lucas points are still used, as are the works pressed type oval exhaust systems.



View of the alternator side shows a complex splayed manifold and engine mounts welded to the cylinder heads.

improvised twin carb conversion and a pair of crackle boxes of about the right size, many a novice was able to start their racing career on a suitably modified Ariel.

Then, as now, the main problem with racing an Ariel was the lack of close-ratio gear clusters. Meier managed to obtain a set for his 1960 TT machine (first 1.85, second 1.42, third 1.09 and fourth 1 to 1) but this was an early version which left a lot to be desired, furthermore, there was a large jump from second to third. It was rather better than the standard ratio of 3.19, 1.86, 1.31 and 1 to 1.

Back at the factory, the lads settled on a gear cluster that changed every pinion and shaft in the box: 1.85, 1.42, 1.19 and 1 to 1. These gears may not be available today, but the needle roller bearing layshaft conversion can still be achieved and is infinitely better under racing conditions than the standard cast-iron bushes. It is only necessary to grind a few thou from the diameter of the layshaft bearing surfaces in order to reduce it to 15mm. These run in an INA RHNA 152116 bearing, which is accommodated in the gearbox end cases by boring the existing bushing to 21mm. With the original top hat section iron bushes removed, side thrust has to be taken up by the insertion of two pegged bronze washers which, incidentally, are the same thickness as the old cast-iron top hat bush section.

General opinion these days has it that only a few close-ratio gearboxes were ever produced. This is rubbish. Many of the ex-factory personnel have told me that the number manufactured actually ran into hundreds. What I think may have happened is that, as they look very much like the road gear cluster (and the older type actually fit the roadster), many have been scrapped or passed on and forgotten, their owners not appreciating what they had in their possession!

The most imaginative piece of engineering I have ever seen was the fitting of a close-ratio Villiers 36A gearbox into an Arrow racer. The guy must have been desperate, because he

hacksawed the original 'box from the rear of the Arrow's unit-construction crankcase, and then welded on a flat plate to which he bolted the flange-fixing 36A 'box. He couldn't fit chaincases, which left the clutch air-cooled, but at least he covered the clutch bearing and primary chain with Copaslip.

They say that necessity is the mother of invention. When it comes to fitting twin carbs to the Ariel, invention has had to run rife: it is certainly a tricky thing to achieve, which is why a lot of people have compromised on the Meier conversion by running theirs with a single unit and standard inlet port. I have seen all kinds of manifold conversion plates fitted in order to achieve a twin carb set-up. The main problem lies with the original casting and the front engine mounting which contains the inlet ports: this has to be removed and an alternative front support fitted.

In my opinion, it's a lot of work for little return. You don't gain another 10bhp/20mph, and for most of us a single 1 3/16in Amal Monobloc gives more than enough power – and it's easy to tune! However, for the masochists among you, here goes. The front engine mount has to be removed to a point approximately 1/4in behind and square to the cylinder base flange. A 5/8in thick alloy plate is then fitted to the newly-machined crankcase with countersunk screws. This provides a flat surface on to which the carbs are then bolted, and allows the new inlet ports to be blended with the original oval ports that remain after machining.

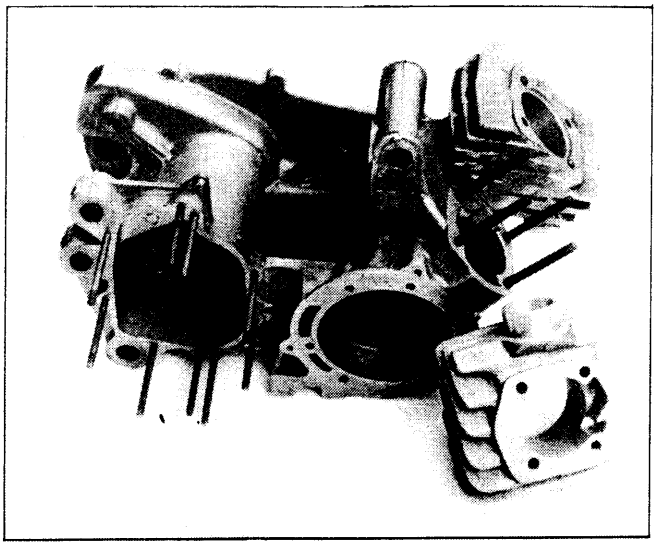
You will find a step on the inside of both new ports that cannot be accommodated by the 3/8in alloy plate. These are normally ignored or filled with Devcon, or a similar filler. But beware! The new ports are steeply down-draught and a Monobloc or Concentric won't work: it has to be a remote float type carb and that's normally an Amal GP2, Dellorto SS1 or a pair of Mikuni carbs from a Yamaha TD1B or C. As to the size, well, I have seen all sizes from 1in to 1 1/4in work well but if you only have a standard wide-ratio box, the limit should be 1 1/8in or 27mm choke diameter.

The unofficial factory machines took their crankcases as bare castings direct from the foundry. The inlet port and standard front engine mount were then removed and the original oval ports filled with weld. The unmachined castings were then put through the normal production machining process which ensured the removal of any irregularities caused by heat distortion that might have occurred during all that alloy welding.

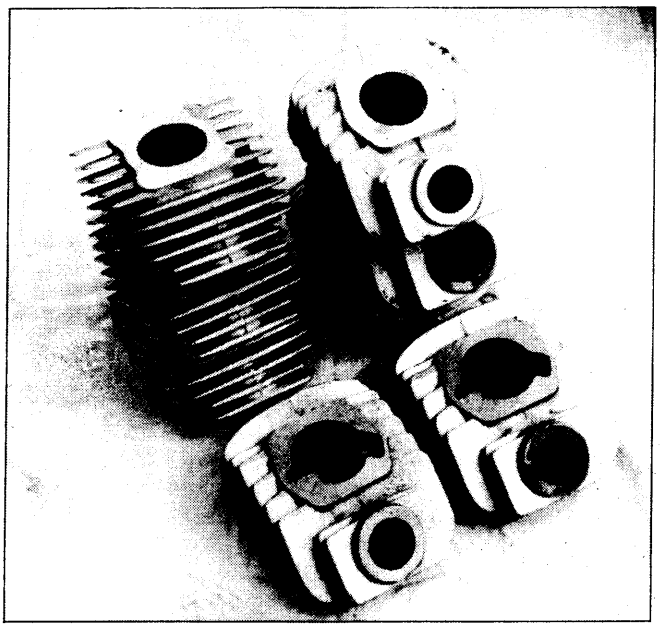
When it comes to racing pistons, look no further than the ubiquitous Suzuki GT250; they are almost identical to the Arrow components, although the small end has to be replaced in order to take the smaller 14mm gudgeon pin. Piston kits and small end bush conversions can be obtained from well-known Ariel specialists, Draganfly Motorcycles. A word of caution though – when enlarging the inlet port, don't make it any wider than standard as the rear skirt of the Suzuki piston is narrower than its Hepolite original and only just covers the port.

Back in the early Sixties, Hepolite manufactured special high silicon Dykes ringed racing pistons (Hepolite no 18550 YKR). There are a few left but as the shop selling them is asking £40 a piece, I won't waste any space giving the name! If you long to use Hepolite pistons for racing, try the Dykes ringed pistons (Hepolite no 16388Y or 15721Y) from the last of the Arrow roadsters – but watch the bore clearance!

Though Meier and his imitators achieved good results by modifying the original cast-iron cylinders, the lads at the factory ran alloy barrels. Up until a year ago, these were as rare as rocking horse manure, but all has changed since Fahron Engineering started manufacturing alloy cylinders with



The five-port engine that was first produced in 1965 by Fahron Engineering.

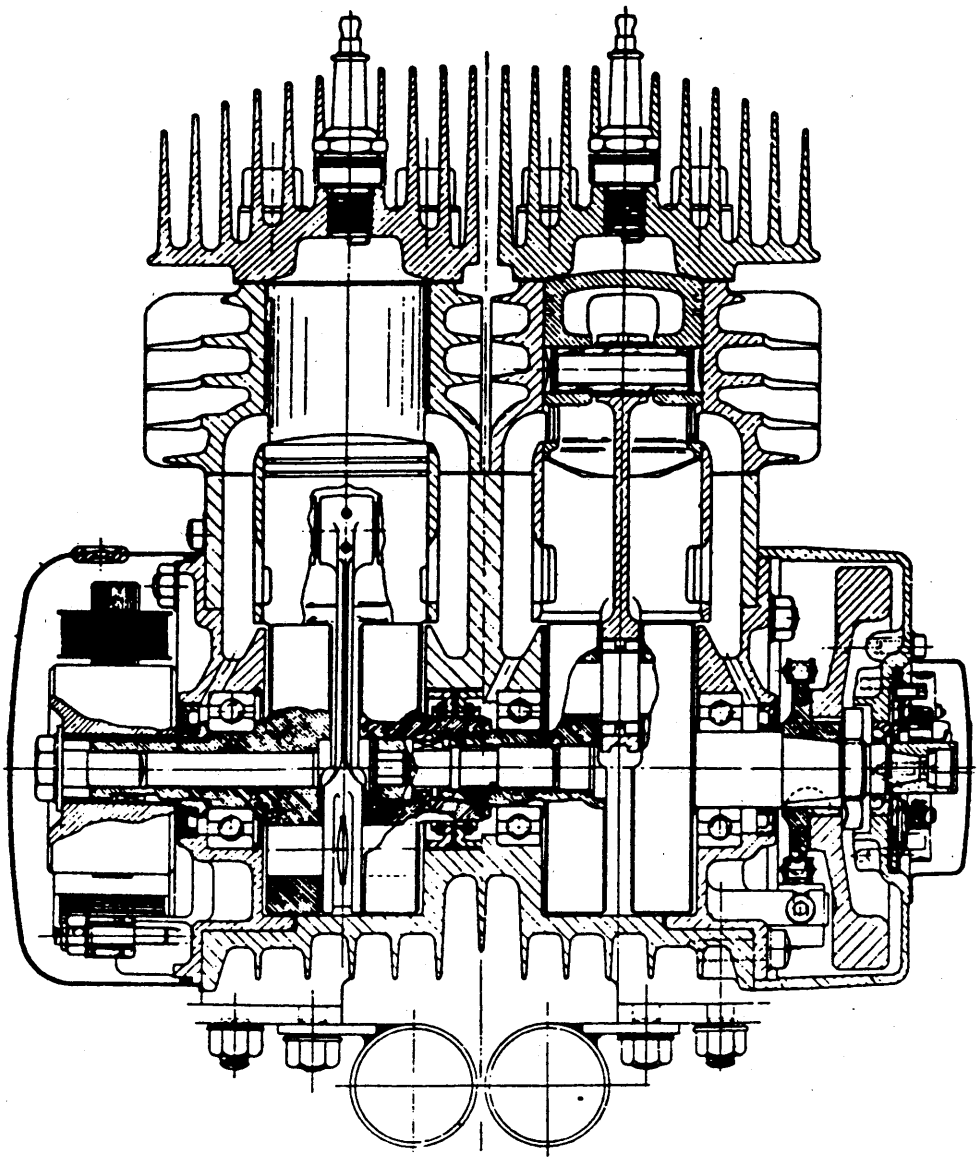


Back in production, Fahron Engineering's cylinders are cast to replicate the original iron lump.

replaceable Meehanite liners which, like the factory alloy cylinders, duplicate the shape of the original cast-iron barrels. (Parkinson's of Colchester developed a large chrome bore alloy cylinder which had approximately 50% more fin area; as you'd expect, these are extremely hard to come by nowadays.)

Thanks to contemporary knowledge of two-strokes, Fahron Engineering can supply either three or five-port versions of their cylinders. Not being restricted to the original oval inlet port in the cylinder spigot, they achieve a more rectangular and better-shaped port. Of course, the best always costs and Fahron's cylinders are £180 a pair which is why, out of 50 enquiries, only one pair has been sold so far. Arrow racers cost little to build, so most owners, it seems, are unwilling to spend that sort of money on a single item – even if it is vital to its success on the track. Remember, most of the power of a two-stroke lies in its cylinder; to draw a comparison, how would a Manx Norton perform fitted with a small port cast-iron head?

Barry Hickmott concludes his tuning tips for the Ariel Arrow in next month's BBM.



MAKING THE *ARROW* *fly*

PART TWO BY BARRY HICKMOTT

BACK TO THE HEAD-BANGERS. You've decided to go for a twin carb conversion, but why stop there? You can still improve the cast-iron barrels by making the following modifications. The exhaust port can be raised to achieve a 185° total opening period, but watch the roof of the port – there isn't much metal there and it's easy to break through the casting. With the standard inlet width, the base of the port can be dropped 3mm and the remaining 180° period achieved by removing metal from the inlet side of the piston. Never slim down or remove the inlet port bridge as the piston will tilt and catch the base of the port leading to rapid wear and eventual piston breakage!

The top of the transfer ports should be raised so that they are open for a total of 135° and, if Suzuki pistons are used, move the rear of the ports to within 8mm (chord) of the exhaust port. The most tedious work involved in modifying an Arrow cylinder lies in increasing the volume of the transfer ports. As well as trying to double its cross-sectional area while keeping its original shape, the crankcases have to be modified to suit. This involves a great deal of hard work and two large piles of swarf on the bench, one cast-iron and the other aluminium, but it has the effect of vastly broadening the

Arrow's power spread, which has been narrowed by increasing the blowdown period. There are other reasons why the transfer volume, transfer/inlet/outlet aspect ratio and other factors are important but as this isn't an article on two-stroke tuning, I will leave it at that.

The final change to the standard cylinder is to remove the base of the transfer window in the spigot and match the inlet window to the increased width of the passage in the crankcases. A final note on porting: keep the exhaust port width to the maximum of 35mm (chord) and try and achieve 15mm radii in the corner of the port window. This will not only help with a gentle pressure wave start into the exhaust which tends to widen the power spread but, most important of all, prevents mechanical damage to the rings at peak revs of 9,000rpm.

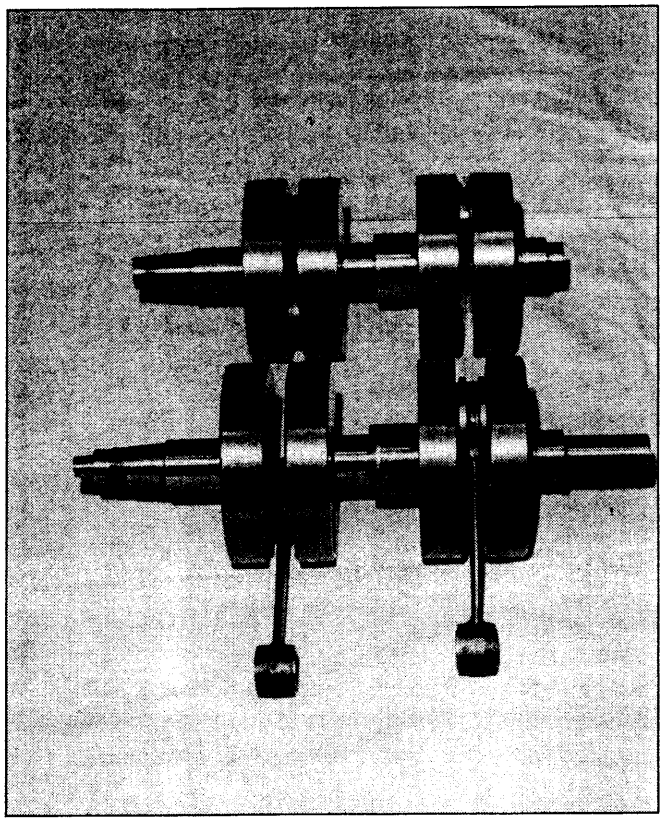
The standard crankshaft is safe up to 9,000rpm and I have heard of them lasting two seasons without attention, but for real power the porting should be designed for 10,000rpm. This was recognised back in the early Sixties but the Selly Oak boys soon found that the ¼in×¼in crowded roller big end gave problems. Not only did big ends fail, but at high revs the big end eye of the fragile conrod elongated, caused by over-the-top inertia loadings. Again, Alpha Bearings were called upon to help with the design of a new crankshaft. They came up with a full-circle padded crank that employed modified Vespa conrods and a 20mm x 26mm x 15mm INA caged needle roller big end bearing.

The above conversion is prohibitively expensive today, as is the fitting of modified Vespa 'rods to the standard flywheels, but all is not lost as Grampian Motors can supply a Japanese manufactured conrod with the same length as the Arrow's, 107mm centre to centre. The main problem is grinding down the 20mm diameter crank pin to suit the much smaller hole in the Arrow flywheels, however, any good precision grinding shop should be able to achieve an accuracy of ±.0002in. A beneficial by-product is that this conversion allows the use of a needle roller small end with the pistons!

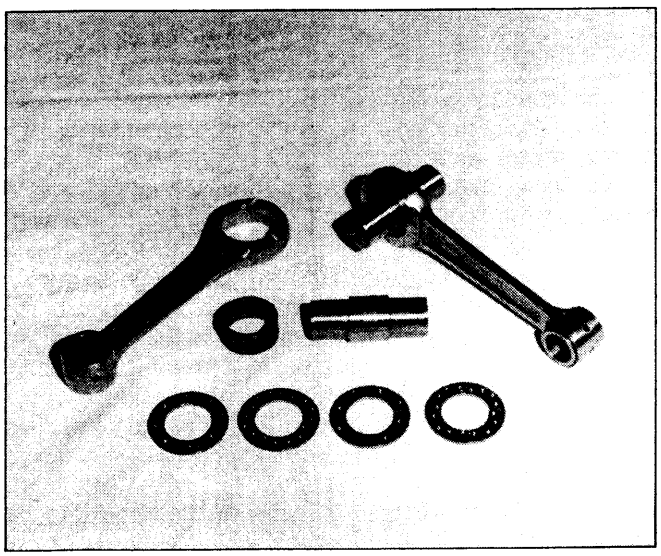
Although critical enough on the roadster, ignition timing becomes doubly so at 9,000 and 10,000rpm, so the standard points are normally ditched. As a direct replacement which, unlike the original set-up, gives individual cylinder timing, you can use the points and back plate assembly from a late Triumph twin. Alternatively, Boyer Bransden's twin transistorised system will fit with the minimum of modification but, if it's the bee's knees you're after, try fitting a Yamaha TZ type Motoplat electronic magneto ignition, set at 1.8mm BTDC, under the alternator cover.

Some people are obsessed with primary compression and pack every nook and cranny with ali, cork, Araldite – anything they can lay their hands on. This is not the answer. The higher the primary compression, the narrower the power band and the increase in power output can hardly be measured. The standard Arrow flywheels are OK but if you must, restrict your enthusiasm to filling in the holes in the flywheels with hollow alloy plugs. Remember the old maxim: you can't get a quart

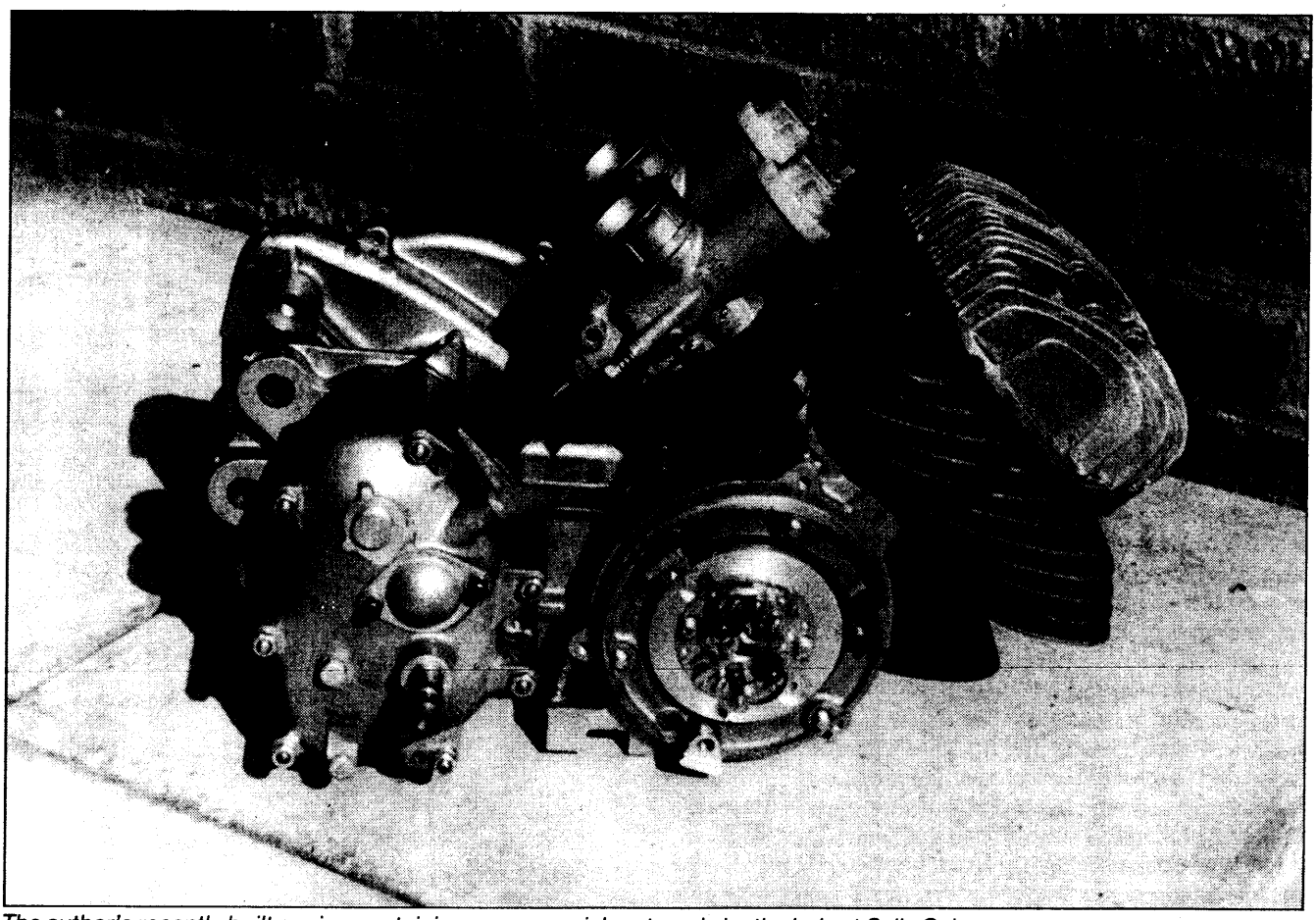
The Suzuki GT250 piston on the left has a narrower rear inlet skirt; modified Arrow piston on the right.



A rare sight indeed: a factory Alpha crank at the top displaying its wider and heavier flywheels. Standard crank with oval conrods below.



A pair of factory Alpha modified Vespa conrods with INA needle roller big end bearings.



The author's recently built engine containing every special part made by the lads at Selly Oak.

out of a pint pot and, as most of you will be starting with a standard wide-ratio gearbox, the wider the power spread the better!

As with primary compression, secondary compression has to be treated with respect. Don't go and shave ½in off the head face and then wonder why there's a hole in the piston after 50 yards. High compression is not the be-all and end-all of two-stroke performance. On the Arrow, the limit is restricted by the die-cast lightweight cylinder head and 12 to 1 geometric is about the maximum. To achieve stability and high compression, the factory lads manufactured special, stronger sand-cast heads. These also incorporated an additional engine mount, replacing the one lost when converting the crankcase to twin carbs.

Whilst the lads were busy developing their racing Arrows, the only official modifications to the production Leader and Arrow models were restricted to conrods, cylinder heads, piston rings, brake anchor points and several changes of brake plate and hub design. Oh, and those terrible 6in single leading shoe brakes – what a disaster! The design office actually produced drawings for a twin leading shoe conversion and totally new 7in TLS front hub assembly, but as production costs would have been high, the project was scrapped. Another interesting development (which actually reached three dimensional status but still came to nothing) was a rather nice tubular-framed Arrow. A couple of these machines saw the light of day but disappeared into obscurity when production ceased in 1965.

Where are all the unofficial factory race machines today? Unfortunately, most of them have been broken up but I have spotted works frames, hubs and crankcases on classic racers, though not necessarily on the same machine. A couple of Hermann Meier Arrows are at present being rebuilt and there are several quick bikes competing in the Vintage MCC's Racing Section, but these are obviously 1958 spec Leaders. The prices of standard road Leaders and Arrows are on the increase as more and more people turn their attention to moderately-priced machines (until they, in turn, become out of reach). So, if you've ever thought of racing an Arrow, you'd better start building it now!

(Readers interested in additional information on building a two-stroke Ariel racer can write to Barry Hickmott, c/o BBM, enclosing a stamped, addressed envelope.)

USEFUL ADDRESSES

Alpha Bearings Ltd, Kingsley Street, Netherton, Nr Dudley, West Midlands. Tel:0384 55151. *Manufacturers of main bearings and mainshafts.*

Boyer Bransden Electronics Ltd, Frindsbury House, Cox Lane, Detling, Maidstone, Kent, ME14 3HE. Tel:0622 30939. *Electronic ignition systems.*

Draganfly Motorcycles, The Old Town Maltings, Broad Street, Bungay, Suffolk, NR35 1EE. Tel:0986 4798. *Ariel spares and services.*

Fahron Engineering, Wighay Road, Linby, Notts. Tel:0602 634123. *Manufacturers of alloy cylinders.*

Grampian Motors, Musker Street, Liverpool, L23 0UB. Tel:051 928 7250. *Importers of Japanese pattern conrod assemblies and pistons to suit AMC, Villiers, etc, two-strokes. (GM can supply a booklet giving dimensions for all the different makes and models.)*

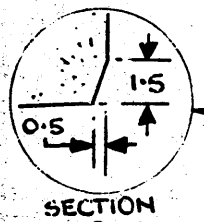
Peter Hepworth Components Ltd, Pool Road, Pool in Wharfdale, Otley, West Yorks. LS21 1EG. Tel:0532 843434. *Manufacturers of Hepolite pistons.*

BRITISH BIKE MAGAZINE

ARIEL

54x54
ARROW AND LEADER.

* PORTING FOR USE WITH ARIEL PISTONS AND STD GEARBOX RATIOS. 8500 RPM.



SECTION

* THIS APPLIES TO ALL PORT WINDOWS AND ALL SIDES.

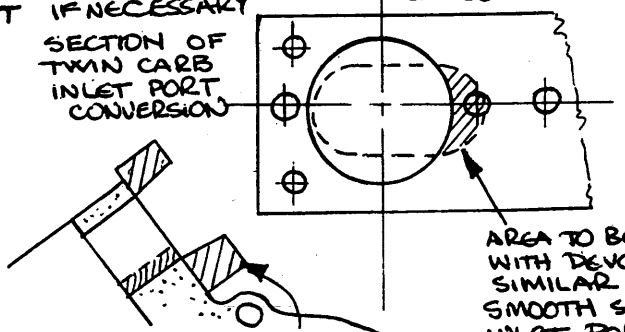
* USE STD 0·1 mm THICK BASE GASKET

NB/

DONT FORGET TO CHECK CON ROD CLEARANCE AND REMOVE METAL FROM LINER SPIGOT IF NECESSARY

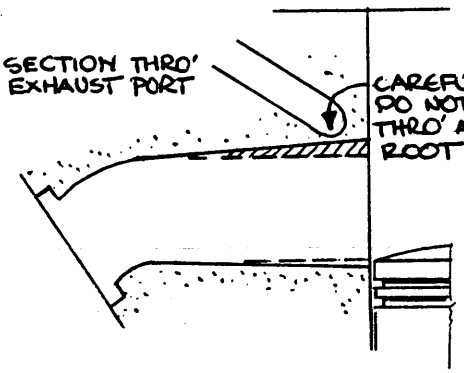
USE SINGLE 30mm CARB. USE TWIN 26 CARBS.

SECTION OF TWIN CARB INLET PORT CONVERSION



AREA TO BE FILLED WITH DEVCON OR SIMILAR TO OBTAIN SMOOTH SHAPE TO INLET PORT

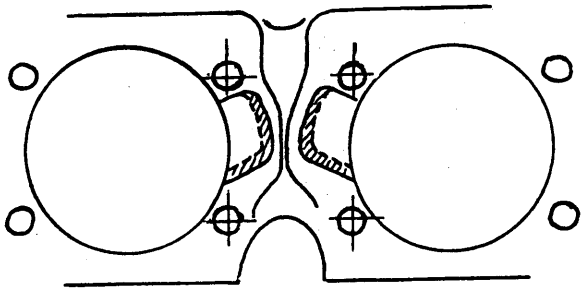
SECTION THRO' EXHAUST PORT



CAREFUL HERE DO NOT BREAK THRO' AT FIN ROOT.

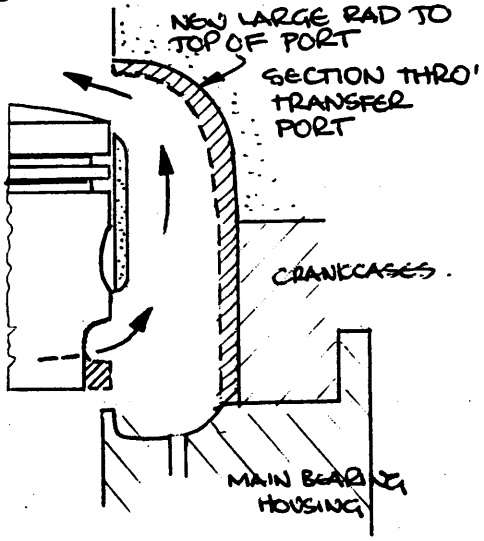
15mm ALLOY PLATE SCREWED TO CASES.

PLAN VIEW OF CRANKCASE TOP



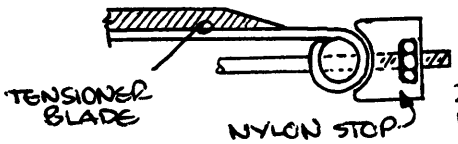
NEW LARGE RAD TO TOP OF PORT

SECTION THRO' TRANSFER PORT



* PRI' CHAIN 0·25mm MAX RUN OUT

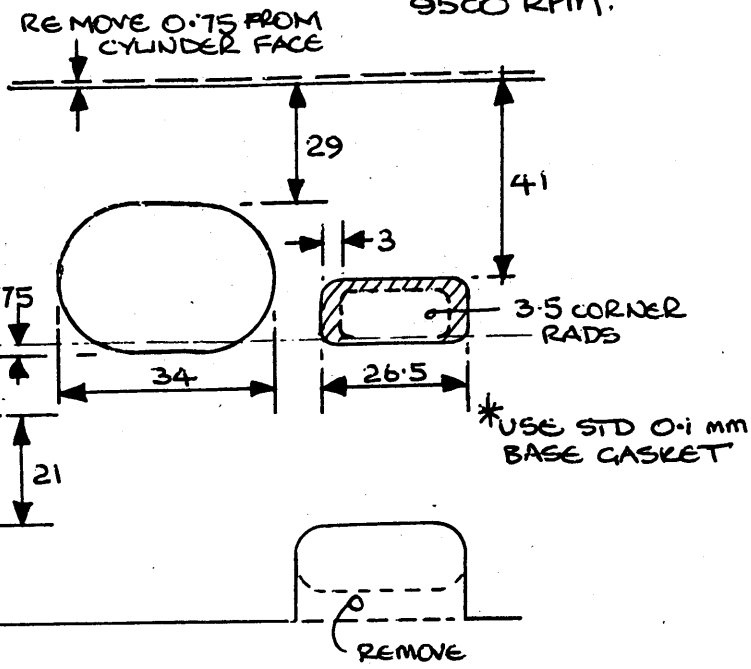
ELEVATION OF REAR OF CHAIN (PRI) TENSIONER.



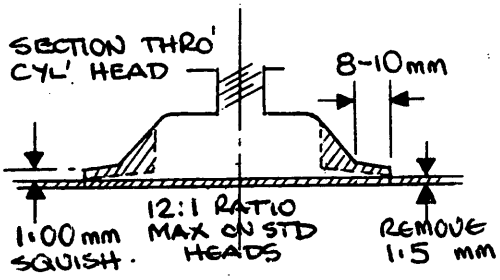
ARIEL TWO-STROKE TUNING TEMPLATE

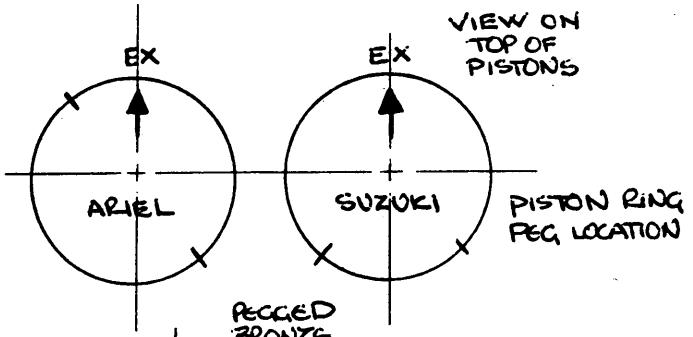
1/ USE CASTROL R30 AT 20:1 IN ENGINE.
2/ USE CASTROL R20 IN CHAIN CASES.
3/ USE CASTROL R30 IN GEARBOX.
4/ SET IGNITION AT 1·8 BTDC AND USE LATE TRIUMPH, TWIN ADJUSTABLE POINTS.
5/ SET PISTON CLEARANCE AT *0·0035" (INCHES)
6/ IF USING SUZUKI PISTONS WITH STD GEARBOX PORTING, REMOVE 0·75 mm FROM TOP CYLINDER FACE AND REDUCE EXHAUST AND TRANSFER PORTS BY 0·75
7/ DO NOT PAD OUT CRANK OR FLYWHEELS.

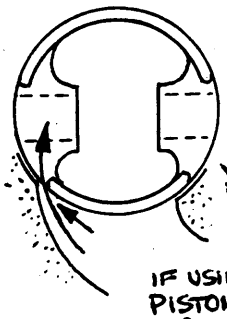
*PORTING FOR USE WITH C/R GEAR BOX AND SUZUKI PISTONS 9500 RPM.



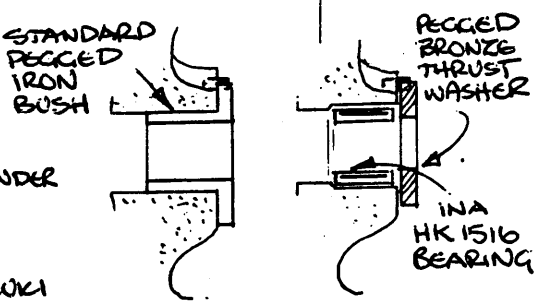
ALL PORT WIDTHS SHOWN AS CHORD.



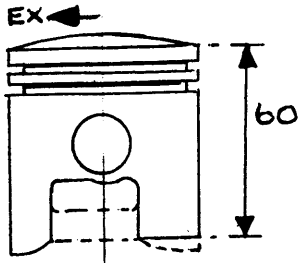




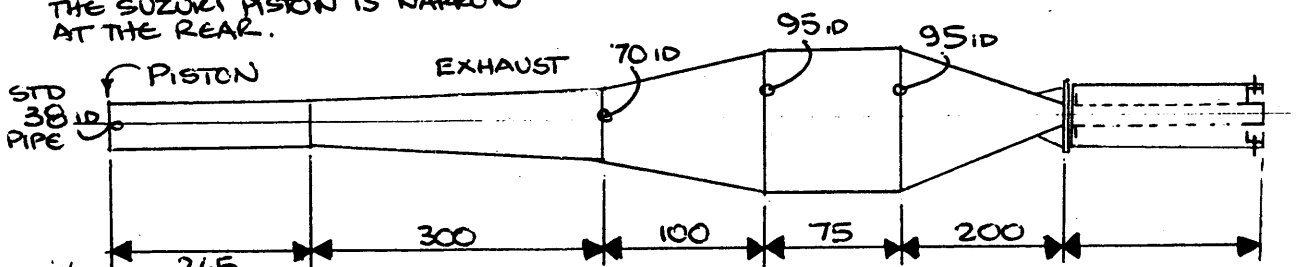
IF USING SUZUKI PISTONS CHOOSE THE CYLINDER CASTING WITH CARE AS SOME DO HAVE A WIDE INLET PORT MOUTH AND THE SUZUKI PISTON IS NARROW AT THE REAR.



SECTION OF GEARBOX LAYSHAFT BEARING



PISTON - SUZUKI AND ARIEL



*STD GEARBOX 8500

225

*CR GEAR BOX 9500

THIS MAY NOT BE THE EXHAUST TO SUIT YOUR MOTOR BUT ITS A GOOD STARTING POINT.

VOLKSWAGEN TAIL PIPE SILENCER 23 ID [BEETLE]