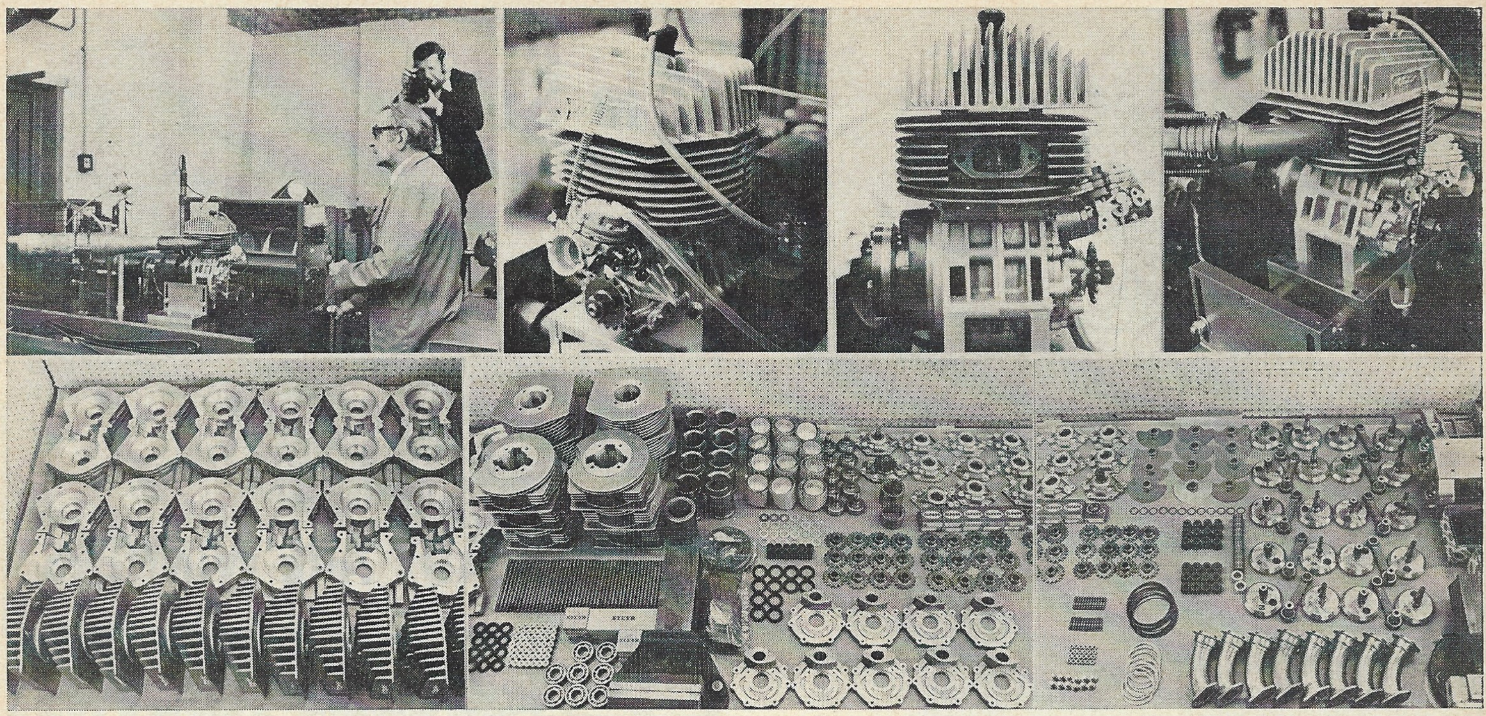

Top left, John Hogan the development engineer on the kart engine project, runs up an Arrow on a dyno. The cigar chewing photographer in the background is Carl Haas, famous N. American importer of racing cars and equipment who will also handle Hewland's USA engine sales.

HEWLAND ARROW UNVEILED

It has been with great difficulty that we have suppressed a growing feeling of excitement over the knowledge that a new 100cc British kart engine was being carefully and patiently developed. At last the wraps are off and the news that Hewland Engineering, who dominate the supply of gearboxes for motor racing to such an extent that one cannot even think of any other firm in existence, let alone as rivals, will send a shock wave around the world. When a company can call on the expertise and skills to manufacture such a difficult product as a Formula 1 gearbox and can back this up with £$\frac{3}{4}$ million of in-house tooling and machinery so that virtually all engineering techniques and practices can be handled without farming out, then this has got to be one of the greatest efforts ever put into racing kart engine manufacture.

Our visit to Hewland was both nostalgic and historic for they are situated at Maidenhead within "piston throwing distance" of Boyne Hill Garage who advertised in our very first issue and were once the importers of the Caretta—the production kart made by the makers of the very first kart in the world. The factory is a complex of buildings that are made up of both purpose-made and existing structures and this results from the way that 53 year old Mike Hewland has built the business up from an old shed over the last sixteen years, which also coincides with the duration of karting in Britain. The elaborate and extremely costly complex machinery is a joy to behold and some of it, for example the facilities for gear cutting and heat treatment, are rare enough to be beyond normal experience.

The design and development team for the Arrow, which comprises Michael Pitcher, John Hogan and Mike Hewland himself, would be the first to admit that the gestation of the Arrow has been anything but rapid or simple. For several years prototypes have been investigated and it is only now that they have finally taken the plunge to produce 12 pre-production units to finally evaluate dimensional accuracy of components for interchangeability and performance whilst in the hands of a selected section of the public. The Arrow KE3 has adopted the basic dimensions of the Komet, that is a stroke of 48.5mm and a bore of 50.8mm, although it should not be imagined that it is in any way a replica of other people's designs for it breaks new ground in just about every component.

The cylinder head is currently a gravity sand casting in heat treated LM25 but will change to a die-casting—as will all the structural castings in the next month or so. It has 14 fins and the combustion chamber is unusual in that it does not incorporate a squish area and has a very shallow chamber that provides a true volume of 7cc and takes a N54R Champion Plug. The head is relieved to take the top flange of the cylinder liner.

The barrel has 8 fins and although cast with a sand core will be shell moulded for accuracy. Plenty of material is left in the wall for additional ports should they be deemed necessary but as it comes the layout is of a divided exhaust, two singe transfers and a TT passage that is perhaps more like a true third transfer than is usual.

The crankcase halves match with a step and recess with the rotary valve half bearing the engine number. A point worth noting is that metric threads are used throughout except that the output shaft bears a left-handed UNF. Four studs of EN16T secure the head to the barrel and the liner is Hepolite in 17 ton tensile cast iron. The bore is ground after the liner is inserted into the heated barrel but it is the Hewland aim to make every possible component in such a way that motors can be assembled with as little hand finishing work as possible.

Hepolite Zip Zed pistons have been found satisfactory and are set up with a 2$\frac{1}{2}$ thou" clearance. There are two thrust washers for side location control on the little end and the bearing itself is caged not only because of engineering dictates but also because they have worked out that the additional cost is saved by the reduction in time over that necessary to insert loose rollers by hand. The big end bearing is a silver plated caged Durkopp that although double the normal price is considered a sound investment. The crankshaft is shaped on the rotary valve side to permit oil to get behind the bearing. The induction tract sweeps in at 15 degrees through the crankcase half and has a 25mm bore at the rotary valve. It is drilled for a Tillotson pulse hole.

We now get to the component which could represent a break-

The centre illustrations show the components and sub-assemblies of the primary reduction gearbox. Working from right to left of the upper row, the crank half has teeth which take the rotary valve drive collar after the main bearing and 'O' ring have been slipped on. Outside the rotary valve cover is the reduction box cover which contains the large internal gear with its large bearing and oil seal. Outside the box cover is the large output chain sprocket and securing nut.

Continued

through in performance, cost and reliability in a 100cc engine, the provision of a built-in primary drive reduction gearbox. It would be pointless to try and claim that this concept is new or revolutionary for right from the very first days of karting people have tried to either reduce or delete the use of chain transmission. There have been engine pinions engaging directly onto an axle gear wheel up to sophisticated (and very expensive) gear drive units incorporating clutches as used today in the U.S.A. What Hewland have done is make the gear reduction unit as one with the motor in a brilliant piece of design work that takes up a remarkably small space and weighs around 14 ounces (400gm). The gear reduction is by 12 and 27 tooth gears to give a ratio of 2.25:1 so that by fitting a normal style engine sprocket but in sizes ranging from 15 to 18 teeth, you use axle sprockets in normal sizes. Once you get on the subject of gears to anyone at Hewland then you are apt to find that they use meaningless technical phrases with an airy wave of the hand for this is the everyday stuff of their lives and they really cannot comprehend that mere mortals may become bemused by the complexity of it all.

The small gear is $\frac{5}{8}$" x 20 with broached serrations whilst the large gear is cut blind and as the profile is corrected involute almost two and a half teeth take the load so they are more than man enough for the job. The large ball bearing is 45/58mm and the whole reduction unit is contained in a cast alloy gearbox that holds 20/50 oil and is filled through a combined filler and level plug.

Even when kart engines were lucky to reach the seemingly dizzy heights of 5000 rpm, chain makers would shrug their shoulders when told of our tiny engine sprockets and say that no chain could withstand such treatment. After flirting initially with British 38 roller $\frac{3}{8}$" pitch, the change was made to 35 bushing type. When this failed to take power outputs of close to 20bhp and rpm of almost 19,000 rpm(!), Italian bushing chain was imported incorporating the BC seize-resistant side plates feature and currently quite a few top drivers now insist on a heavy weight KBC version. As individual clubs and whole countries have moved towards banning chain oilers so the situation has been aggravated to the point where "factory selected" chain has joined the list of desirable goodies for those seeking the ultimate performance.

It is that terrible 9-tooth sprocket that is the real villain of the piece for it must be adopted whilst lateral rotary valve induction is adopted if it is on the same side as the output shaft. Unless smaller diameter ignition can be developed that will permit the carburettor tract to enter just above it, then the Arrow solution of lowering the drive shaft and providing gear reduction at the same time appears to be the only possible solution. The net result is that instead of having sizzling hot chain at the end of a race, it remains completely cool with the Arrow whilst the move to a large output sprocket brings many benefits of its own. As one reduces the size of a sprocket from around 19 to 9 tooth so the graph of this against change in pitch circle follows an alarming curve. By the 9 tooth size there is an 8 per cent change in pitch circle during rotation—the reasons for which I will not attempt to describe in words but which Mike Hewland can easily demonstrate with his hands! The effect is that the distance between the drive and axle sprocket is violently changing so the chain is alternately slack and taut so it thrashes and thus absorbs power, generates heat and aggravates the reliability of both chain and sprockets.

The rotary valve is of Swedish stainless steel and has a triangular shaped drive collar. The crankshaft balance factor is around 40 per cent which, from Hewland's tests, appears much higher than most Italian motors. The stuffing of the crankshaft wheels is very interesting for it is achieved with LM4 and secured without rivets but purely by a heat cured film adhesive. It would need around 1200 lbs. to shear the alloy and the curing is carried out for 3 cranks at a time. The forged connecting rods bear "Hewland" in relief and have a single slot for big end lubrication.

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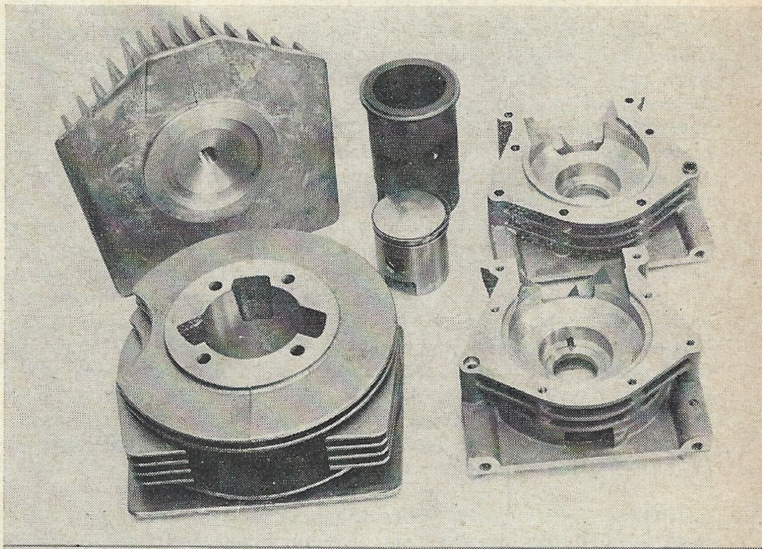

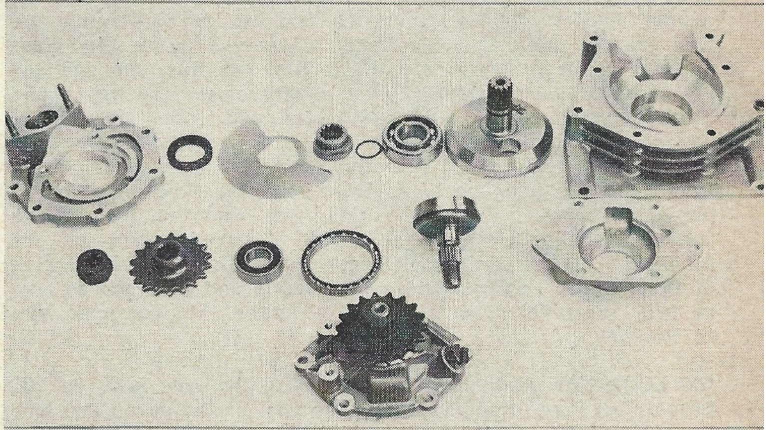

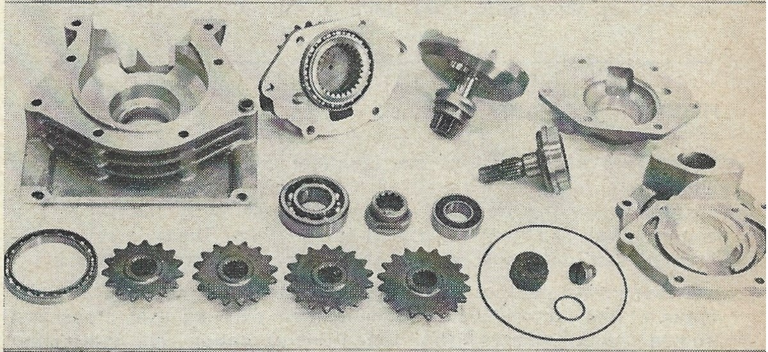

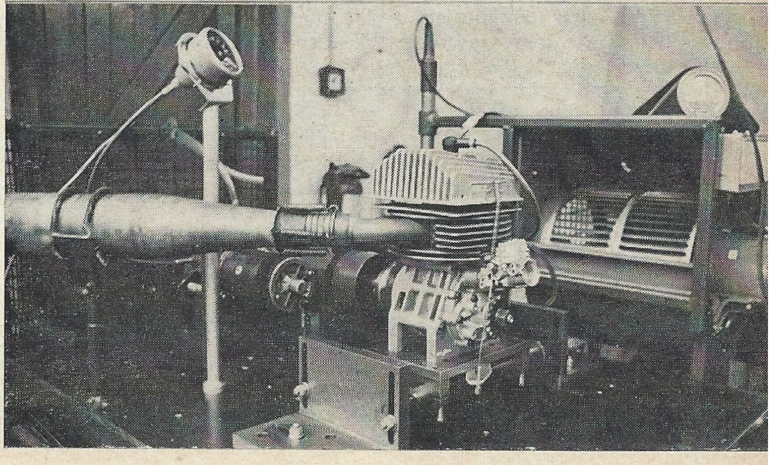

HEWLANDS ARROW continued.

The two main bearings are identical and on the rotary valve side there is a small seal on the shaft to prevent oil being sucked from the gearbox—an early fault with the prototype engines that had them mystified for a while. There is no crankcase oil seal until one reaches the rotary valve cover plate.

A surprising number of normally bought-out items are actually made at the factory and they have their own exhaust stubs and engine mount plates, the latter incorporating an interesting scoop to carry cooling air under the crankcase as they have found that the temperature in this area is very critical in relation to power fade. On the dyno the Arrow is providing good outputs that are comparable with a well performing Italian motor but they are putting a lot of effort to try to ensure that all motors are reasonably consistent rather than having a Maverick few with exceptional outputs. For the future they hope to try and use roller chain which should reduce friction even further and so aid the power actually reaching the rear wheels.

The engine is to be homologated for class 100 Junior National and National by the RAC effective 1st April and this should give them plenty of time to tackle FIA homologation and competition in twenty months time. At a period when the Italian producers seem to have more than their usual number of problems as to inflation and exchange rates, the release of the Hewland Arrow could not have come at a better time. Let's hope we will be able to hear the distinctive noise of those meshing gears out front soon.