MC 17/6/70

THE TECHNICALITIES of the Ariel 3 are extremely interesting. Forward from the seat pillar, the little trike is more or less orthodox moped, with a beam frame formed from two edge-welded steel pressings; and if the trailing-link front suspension seems familiar, recall the Triumph Tina scooter, which had an almost identical arrangement.

The unconventional features are rearward of the saddle, where the bodywork conceals a Dutch-built 49 cc reed-valve, fan-cooled, Anker two-stroke engine. This unit, with centrifugal clutch on its mainshaft, is mounted on a massive yet light cast-aluminium yoke, the arms of which carry the axles of the two rear wheels.

Drive from the engine is by toothed belt to a countershaft, then by enclosed chain to the live axle of the left-hand wheel; the right-hand wheel is not driven, so there is no need for a differential.

The pedalling chain, too, drives the countershaft and is used mainly in starting although, in emergency, a dog clutch at the left-hand end of the countershaft can be disengaged manually to permit the machine to be pedalled like a cycle without driving the engine shaft.

When the engine fires, a sprag clutch (freewheel) on the engine shaft overrides the pedalling mechanism.

Most unusual part of the layout is the double trunnion by which the rear-yoke casting is coupled to the open end of the frame main beam. Here there is one pivot lying in the fore-and-aft plane, which permits the fore part of the machine to bank over to the left or right, and a second pivot at right angles to the first by which the whole rear section becomes, in effect, a pivoted fork.

Both rear springing and limitation of bank are under the control of two long torsion rods. The rods lie side by side and are clamped at the rear to the yoke casting. They extend forward within the frame beam to an anchor assembly ahead of the pedal-chain wheel.

As the rear assembly pivots in an up and down plane, the rods provide a springing medium by bending. Banking puts the rods in torsion and, as the bank increases, so there is a progressive build-up of resistance.

Adjusting screws at the front anchor assembly permit preloading of the torsion rods to suit the weight of the rider. Also, of course, when unladen the torsion rods return the machine to an upright position.

Limitation and damping of the rear springing are achieved by a rubber snubber which surrounds the upper attachment bolt of the trunnion block.

All three wheels are pressed-steel, and are shod with Dunlop 2.00 x 12in tyres. Wheels are attached to the hubs by three studs and are interchangeable; if required, a spare wheel and carrying bracket can be supplied.

Brakes are 4in-diameter and are fitted only to the front wheel and left-hand-rear (driven) wheel. Provision of an automatic clutch means that the left side of the handlebar is free to carry a rear hand-brake lever, with a sprag to lock the brake on when the bike is parked; on that side of the bar, also, is a spring-trigger carburettor choke control.

On the right of the handlebar is the front-brake lever, and a twistgrip which, when rotated forward beyond the closed position, operates a cylinder-head decompressor for starting and stopping purposes. Ignition and lighting are direct six-volt, from a flywheel magneto.

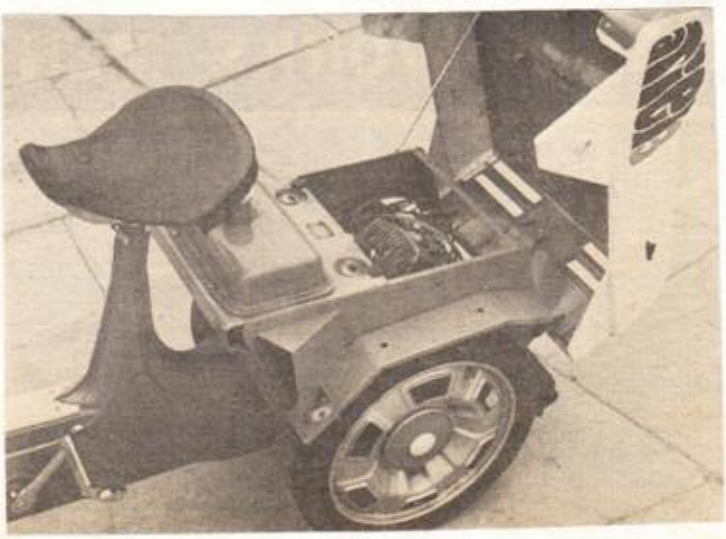
Equipment includes an injection-moulded plastic front apron and legshield which incorporates, on its front face, a registration plate. Under the rear bodywork is a 1½-gallon petroil tank, and the top surface of the body pressing is ribbed to serve as a carrier platform.

At extra cost, a wire shopping basket for the carrier can be supplied; available also are a handlebar windscreen and handlebar mirrors.

Total recommended price of the Ariel 3, including British purchase tax, is £110. Makers are the Ariel division of BSA Motor Cycles Ltd, Armoury Road, Birmingham, 11.

TYRE PRESSURES = 28psi (all)

BSA launched the Ariel 3 three-wheeler in July 1970. With a Dutch-built 50 cc engine and fully-automatic transmission, it was expected to be the answer to the housewife's dream. Unfortunately, its price was high compared with convential mopeds and, although it is still listed, hundreds of engines have been sold at little more than scrap prices



MC 1/7/70

IS IT a moped, a trike or what? The simple answer is that the Ariel 3 is a mixture of the two — a three-wheeler to attract those who would feel unstable on two wheels, but with the manoeuvrability and ease of parking of a moped.

Like a moped, it has simple controls, with both brakes operated by handlebar levers, a trigger choke control on the left side of the handlebar and a twistgrip throttle (which, when rolled right back, opens the decompressor) on the right.

When cold, the test model's engine was a little reluctant to fire, and 10 yards of pedalling with the choke applied were necessary. Another few yards, and it would idle quietly and regularly without the choke.

The centrifugal clutch was extremely smooth in operation; even when pulling away on fairly steep gradients, it was unnecessary to pedal. Acceleration was lively by moped standards.

Although the Ariel is aimed to some extent at those who would not trust a two-wheeler, cycling experience makes it easier to ride at first. The immediate impression is of riding a normal, light two-wheeler with a puncture in the rear tyre, but it soon becomes obvious that the Ariel's intentions are honourable. And, in most circumstances, it feels more stable than an orthodox moped.

Experiments for test purposes showed that if a corner is taken too fast, the rear wheels drift out, speedway style, in a series of minor slides. The sensation seems strange at first, but the result is certainly not dangerous. It is just about possible to fall off — if the trike is banked to legshield-scraping angles, the front wheel will slide away.

On bumpy bends, the rear end may step out quite suddenly, and on badly rippled surfaces the rear wheels tend to hop. But although all this feels uncomfortable, the trike's inherent stability wins through.

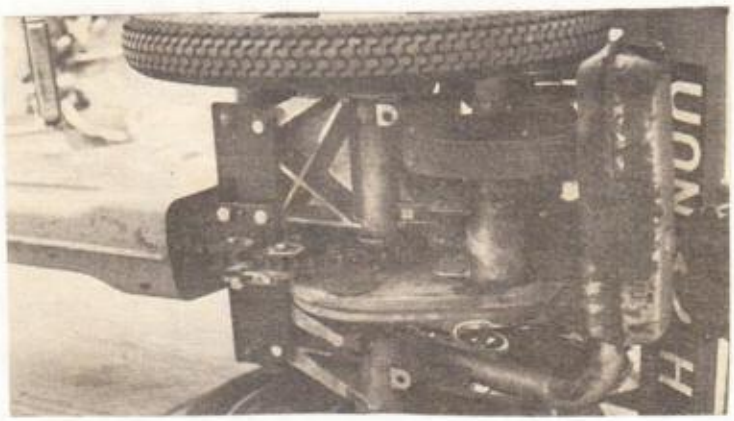
Braking is outstandingly good, and despite the bias that must be imparted by having only one braked wheel at the rear, there is no suggestion of pulling to one side.

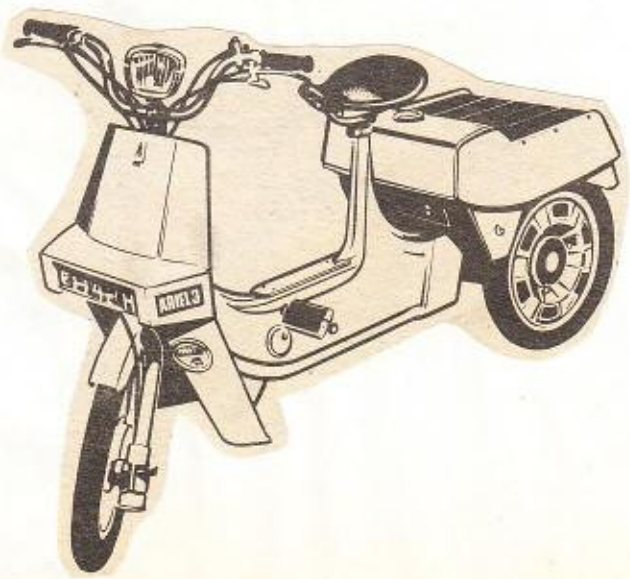
Paced against a car (no speedometer is fitted), the Ariel's top speed was found to be close to the maker's claimed 30 mph. Fuel consumption, under commuter conditions, was distinctly better than 120 mpg. The tank, mounted over the engine, holds six pints of petroil — which means a very "safe" half-gallon fill up.

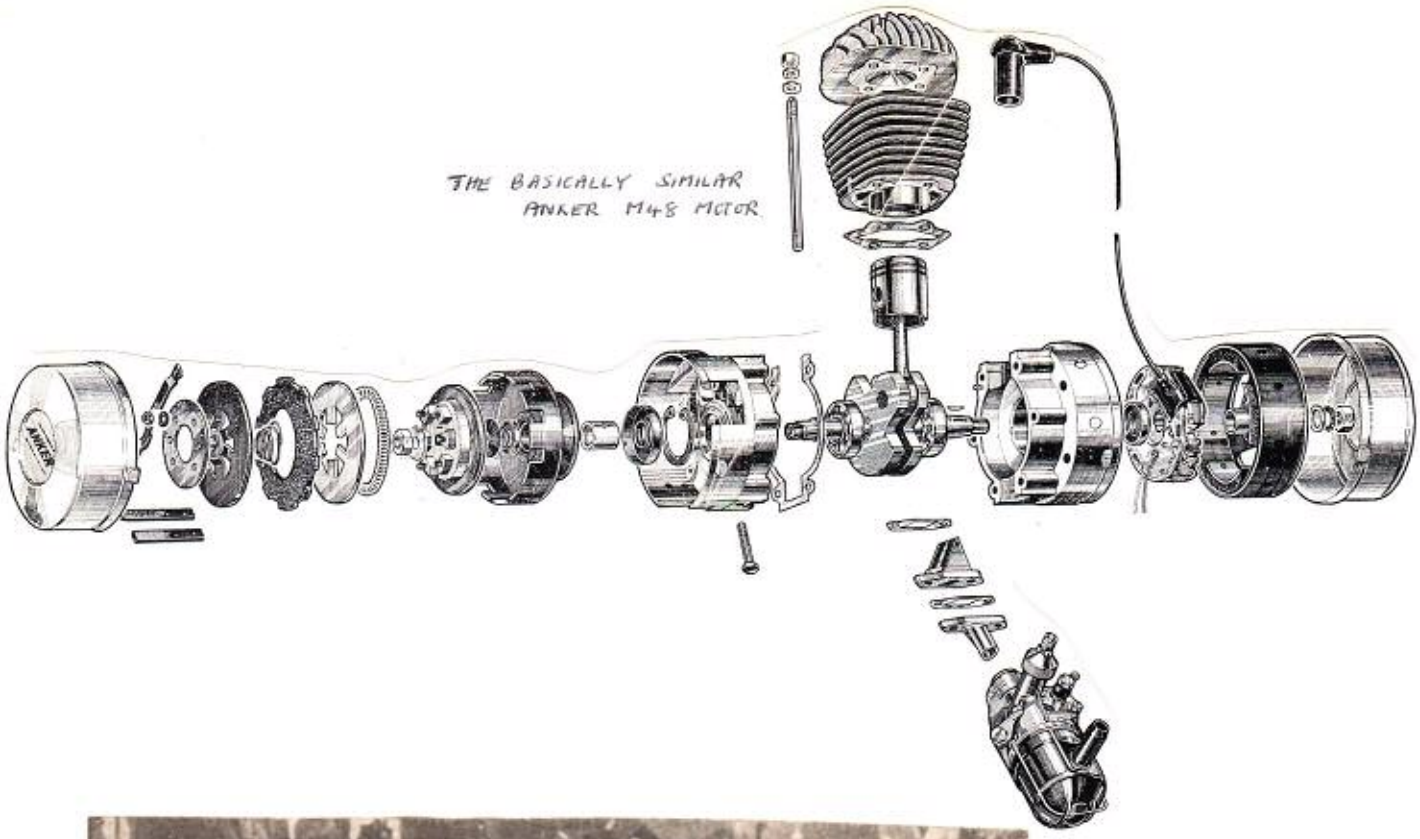
Powered by coils in the flywheel generator, the headlight is bright enough for the performance of the Ariel; there is no dipping filament. No parking lighting is fitted. The horn is inadequate, even for a machine of this size.

Various extras are listed. The machine tested was fitted with the rear-mounted shopping basket — very useful — and a tinted windscreen. Since there is no ignition switch, an additional worthwhile extra would be the anti-theft lock, which fits in the front suspension link and prevents the wheel from turning.

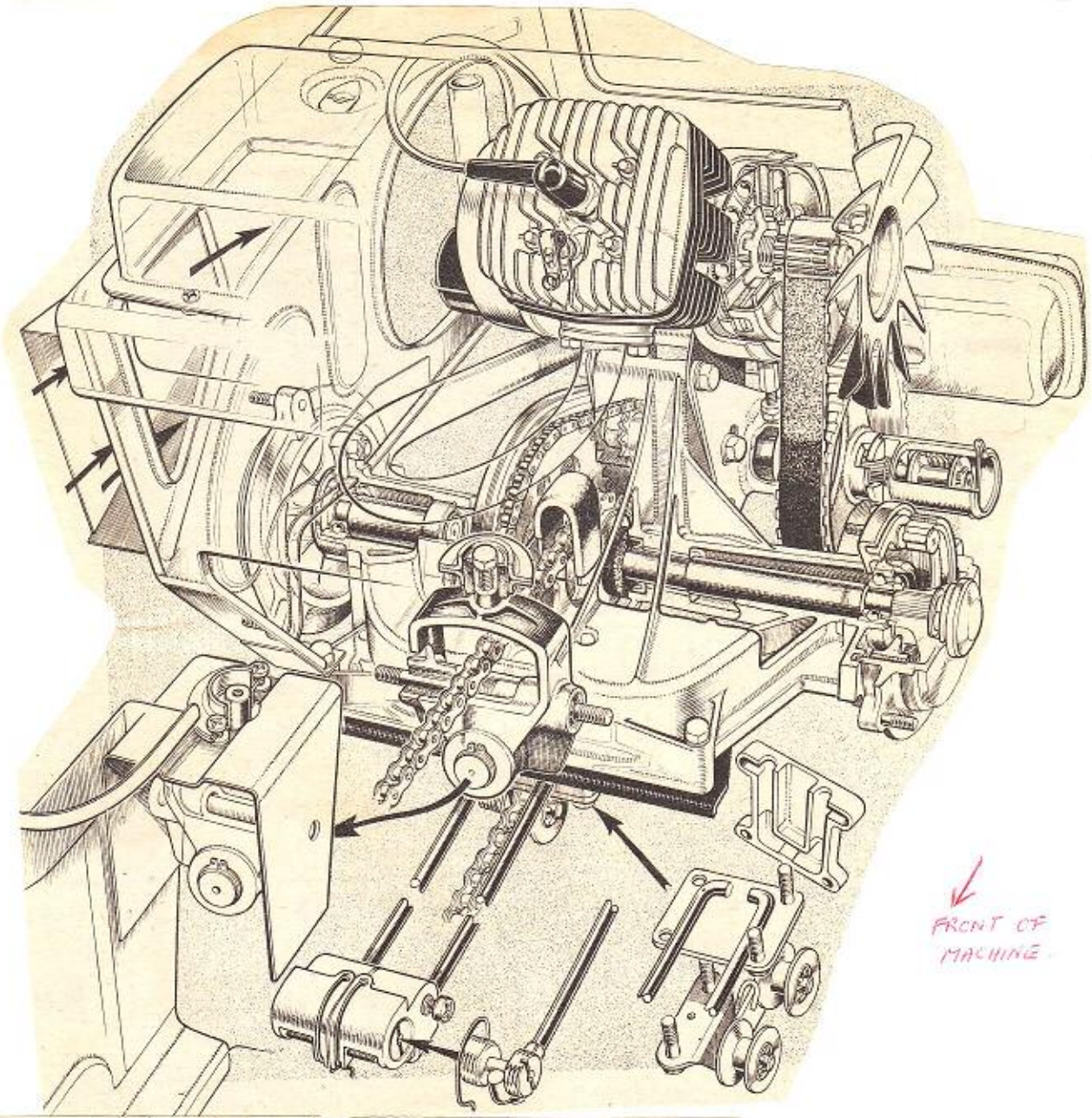
ENGINE: 49 cc (40 x 38mm) reed-valve two-stroke single. Crankshaft supported in ball bearings; roller big-end and plain small-end bearings. Lubrication: petroil, ratio 24 to 1. Compression ratio: 7 to 1. Carburettor: Encarwi 8mm with wire-gauze air filter; choke operated by handlebar-mounted trigger. Claimed power output: 1.7 bhp at 5,500 rpm.
TRANSMISSION: Primary by toothed rubber belt to single-plate centrifugal clutch; secondary by fully enclosed chain to near-side rear wheel. Overall reduction, 12.55 to 1.
ELECTRICAL EQUIPMENT: Ignition and direct lighting by six-volt flywheel magneto with lighting coils. Headlamp: 4in wide, square pattern, with 17-watt bulb.
SPECIAL EQUIPMENT: Plastic-covered wire shopping basket; tinted Perspex screen.
FUEL CAPACITY: Six pints.
BRAKES: 4in-diameter single-leading-shoe front and rear, the rear working on driven wheel; cable adjusters at the shoeplates.
TYRES: 2 x 12in Dunlop studded on interchangeable, pressed-steel wheels.
SUSPENSION: Trailing-link front controlled by micro-cellular polyurethane blocks. Rear by torsion bars; damping by rubber snubber block.
DIMENSIONS: Wheelbase, 49in; ground clearance, 3¼in; seat height, adjustable from 28½ to 36in; all unladen.
WEIGHT: 98 lb, including ½ gallon of petroil.
PRICE: £110, including British purchase tax. Extras: carrier basket, £1 15s; screen, £2 12s 6d.
ROAD TAX: £2 10s a year.







Two months after the official launch of the Ariel Three several machines were featured at a charity event at London's Battersea Park. *(1970)*



Engine, countershaft, primary and secondary drives, and the two independent rear-wheel axles, are all carried on a massive light-alloy fork, which pivots on a transverse spindle inside the rear end of the main frame beam.

Below this spindle, and mounted in the same trunnion block, is another longitudinal spindle which permits the fore part of the machine to cant to left or right while the rear section remains firmly upright.

The 2ft-long spring-steel torsion rods control both rear springing and banking. Their rear ends are clamped to the underside of the fork casting. (Two nylon pulleys, attached to the torsion - bar clamp, guide and tension the pedalling chain).

The other end of each rod is attached to an anchor block, mounted ahead of the pedals, in the main frame beam. By means of an adjuster screw at each side of this block, the torsion rods can be preloaded to suit the rider's weight.

Springing of the rear assembly is controlled by bending of the rods. Banking causes them to twist and, as they unwind, so they restore the front part of the machine to the vertical.

Carried on the left side of the Dutch-built 50 cc Anker two-stroke's crankshaft is the single-plate clutch, which automatically disengages at low revs. As engine revs rise, a ring of balls enclosed in a continuous spring cage move outward under centrifugal force and, in following the contour of their outer cover, apply pressure to the clutch plates, so taking up the drive.

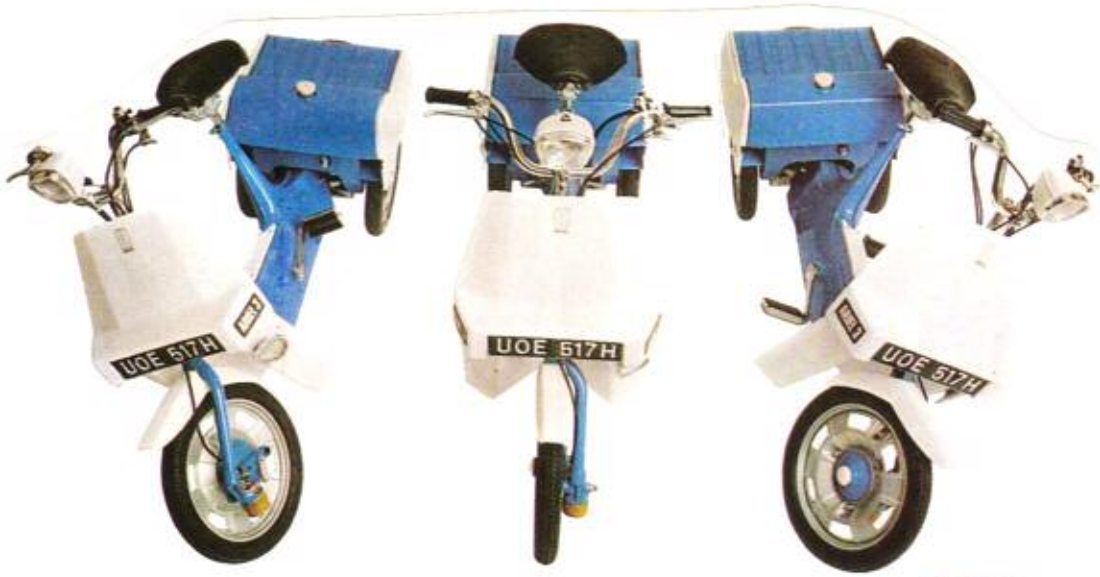
Outboard of the clutch is a pulley for the toothed-belt primary drive, carried on a Torrington needle-roller bearing and embodying a sprag freewheel. At the end of the shaft is the cooling fan.

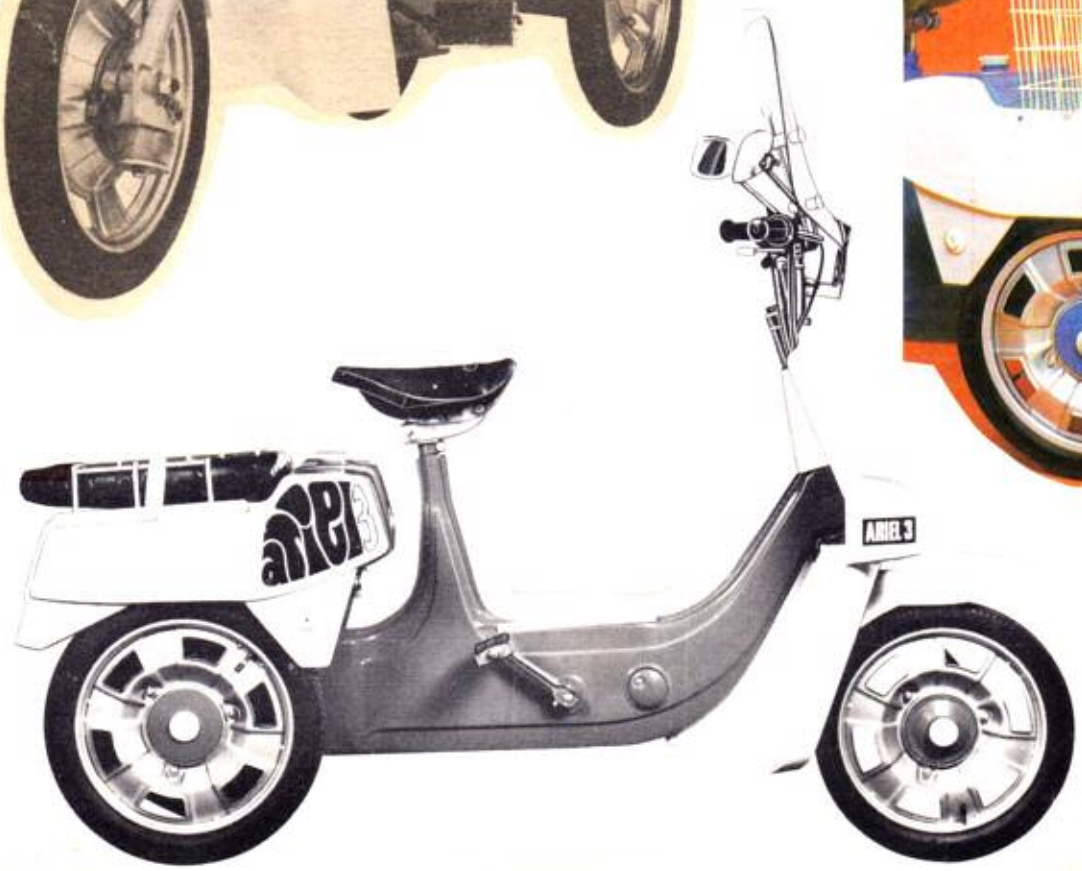
The countershaft, mounted below the engine, has at its outer end a dog clutch which can be disengaged manually (against spring pressure) should one want to pedal without turning the engine.

Inboard is the enclosed final drive connected to the live, left-side rear axle. Only the left wheel is driven. Normally, the pedalling chain operates the engine and, through an orthodox, cycle-type freewheel, drives the left-hand rear axle.

When the engine starts and takes up the drive, the freewheel over-rides the pedalling mechanism. The sprag freewheel on the crankshaft allows the engine to be rotated for starting purposes, but disengages when it fires.

A brake drum is embodied in the hub of the left-side wheel only. However, all three wheels are interchangeable; each is attached to its hub by three studs.





3/72

GEORGE WALLIS, designer of the ingenious Ariel 3 moped, has built a Mk 2 prototype. As with the original, the front wheel and beam frame are banked for cornering, while the rear wheels remain upright.

Among the improvements are automatically-variable gearing, a kickstarter, three brakes instead of two, and an increase in luggage-carrying capacity from 50 to 112 lb.

The engine has been moved from rear to front to give better weight distribution, get the luggage low down between the rear wheels, and eliminate the need for a cooling fan. Wheel diameter is 4in greater, and the tyres (2.25 x 16in) are fatter.

Springing is now by telescopic fork at the front, wishbones and coil springs at the rear. At 18in, track is 3in wider; ground clearance is increased to 5in. Weight is 115 lb.

Top speed remains at about 30 mph, petroil consumption some 125 mpg. A brief test revealed extremely easy starting (even by hand), very smooth drive, remarkable stability and ample springing for heavy loads.

Estimated selling price is £120. Other prototypes include an unsprung pedal version, to which an engine could be added to make a very inexpensive utility moped, and a commercial version with a carrying capacity of 3 cwt.

With the Ariel 3 a victim of the BSA financial crisis, Wallis is seeking a manufacturer for the Mk 2.

As anyone knows who has seen an Ariel 3 (based on Wallis' Mk 1 prototype), the rider banks the front wheel and frame for cornering, while the rear wheels remain upright. The inherent stability of the layout stems from the geometry of the articulation as well as from the effect of the torsion bars (which also keep the machine upright when parked). Let us look at the articulation first.

The axis about which the front of the machine banks passes just under the rear axle and rises 4 deg from the horizontal towards the front.

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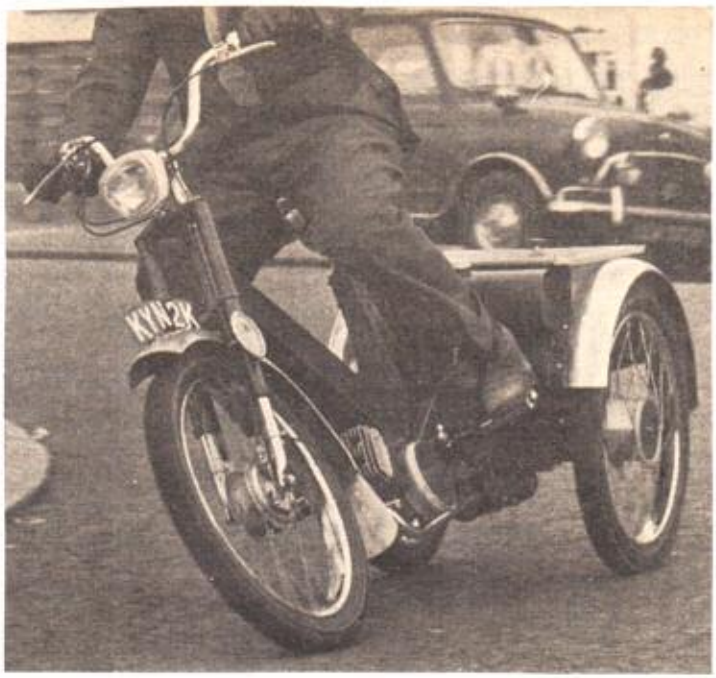
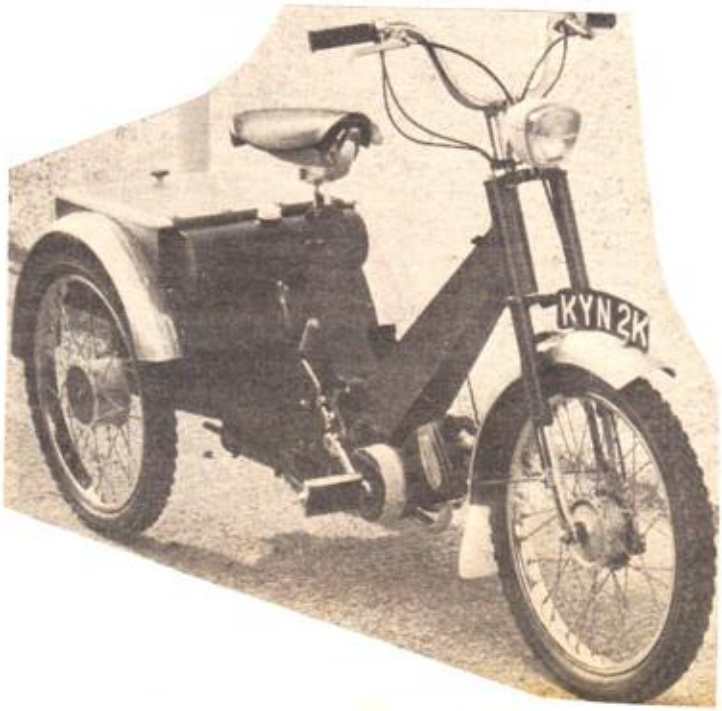




Since a forward projection of the pivot axis lies well above the contact patch of the front tyre, banking the wheel levers the axis towards the bend, so turning the rear axle inward. The first two pictures of a scale model show this very clearly.

Similar to understeer of a car, this effect greatly inproves cornering stability (particularly as a banked front wheel tends to oversteer). It also practically eliminates scrubbing of the rear tyres when cornering.

Clearly, the understeer characteristics vary with the upward inclination of the pivot axis. If this is steepened the leverage is increased and the rear axle turns in farther for a given angle of lean.

But as the axis is turned inward it is simultaneously lowered. And once it is horizontal, further banking produces no more understeer.

So the angle of inclination of the axis determines not only the degree of understeer but also the range of banking over which it continues to increase.

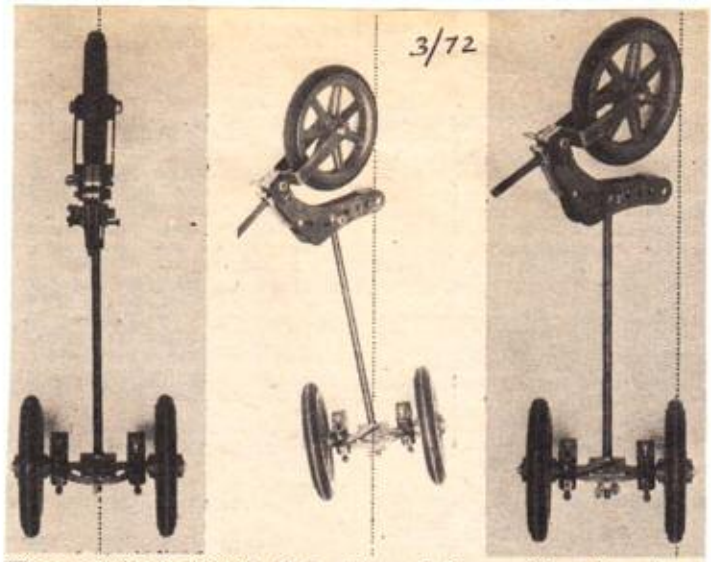
For example, the 4-deg inclination on the moped gives progressive understeer up to 35 deg of bank and no more. For a high-performance three-wheeler, the effect could easily be extended to, say, 50 deg of bank.

(Indeed, George Wallis claims that, if necessary, a simple cam arrangement could be incorporated in the front of the pivot to prevent any limit to understeer.)

The other important effect of the articulation is shown in the remaining scale-model picture. This is the outward movement of the front-tyre contact patch as the machine is banked. Again, the effect increases as the pivot axis is inclined farther upward.

The result is that, in a corner, the front wheel virtually takes up the position of the outer front wheel of a car — that is, the wheel that shoulders an increasing proportion of the load the harder the car is cornered.

In other words, the central front wheel in the Wallis design virtually becomes a left or right front wheel in corners according to which way the trike is turning.



These overhead pictures of a scale model on a datum line show how the rear axle automatically turns inward when the front wheel is banked. With the outer rear wheel aligned on the datum, it is clear how the front wheel moves outward when banked

As mentioned earlier, there is another resistance to overturning, in the form of two torsion bars (straight rods that act as springs when twisted).

Each bar is located longitudinally on one side of the frame, and is cranked outward at the rear for connection to the wheel.

Since the front end of the bar is clamped to the frame, banking the frame towards the wheel twists the bar — and, through the cranked arm, applies downward pressure to the wheel. At the same time, the twist in the other torsion bar applies upward pressure to the outer wheel.

These pressures oppose the overturning effect of centrifugal force, to give substantially equal wheel loading at all cornering speeds.

There is, of course, no tendency for the banked part of the machine to overturn. As with a solo (Technitalk, March 8), centrifugal force and weight balance one another and the resultant force acts in the plane of the frame, through the front-tyre contact patch.

Naturally, a racing three-wheeler on Wallis lines could hardly have the engine at the front, because of the relative twist between it and the rear wheels. On the Mk 2 moped, the twist is accommodated by the vee-belt in the variable final drive. (This has expanding-contracting pulleys, and gives an overall range from 24 to 11 to 1.)

The Wallis princples described are patented in 11 countries. Anyone interested in manufacturing the Mk 2 moped or constructing a racing three-wheeler should get in touch with G. L. Wallis and Son Ltd, Lenelby Works, 74 Lenelby Road, Tolworth, Surbiton, Surrey.