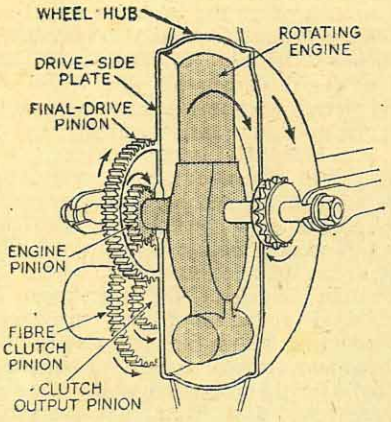
A Rotary-engine Wheel of 40 c.c.

Details of the Fascinating T.I. Power Wheel : A Design Which Provides Much Food for Thought



Diagrammatic section showing the rotating engine and transmission to the hub shell

FORMING as it did a centre of intense interest at Earls Court, the sensational Tube Investments Power Wheel for cycles is a design of outstanding technical merit. This 40 c.c. rotary two-stroke unit, in which the fixed crankshaft serves as the wheel spindle and the whole mechanism is enclosed in a neat 11in-diameter hub drum, was conceived some four years ago by Cyril G. Pullin, well known both as winner of the 1914 Senior T.T. and as a designer in motor cycle and aircraft spheres. It bids fair to fulfil its designer's primary aims of vibrationless operation, maintenance-free transmission, and adequate cooling under the most adverse conditions.

The hub consists of a shell to which are attached two side-plates; the engine revolves between these plates. Outside the left-hand plate is a double-reduction gear drive, and enclosing this is a fixed plate which accommodates a multi-plate clutch, A.C. generator and the shoes of an internal expanding brake.

A 16-gauge steel pressing, the hub shell has a ring of holes around the middle of its periphery for the egress of air. A hinged flap provides access to sparking plug and compression-release valve.

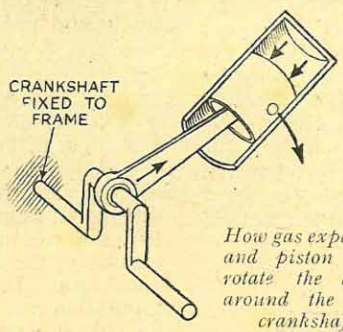
Called the sprocket plate, the right-hand side-plate is a brass pressing attached to the shell by 20 countersunk screws: it contains radial slots for the ingress of cooling air, plus a movable panel giving access for contact-breaker adjustment. On a central threaded boss is mounted the pedalling chain free-wheel sprocket. Within this boss is the journal ball race which supports the side-plate on the fixed crankshaft-cum-wheel spindle.

Also attached to the hub shell by 20 screws, the left-hand or drive-side plate is a light-alloy die-casting. Riveted to its outer face is the steel final-drive pinion. Around this pinion are two concentric flanges; the inner one forms the 6⅞in-diameter brake drum.

The annular space between these two flanges provides a channel for the exhaust gases, which enter it from silencers on the rotary engine via wide slots in the wall of the side-plate. The outer flange, in conjunction with a nylon seal fitted in the fixed plate, makes the outer gas seal for this exhaust channel.

A large ball race housed in the centre of this plate supports it on the engine pinion boss which itself contains a smaller ball race for its own support on the fixed crankshaft. Although it is positioned outside the left side-plate, the engine pinion is splined to, and therefore rotates with, the crankcase.

Inner seal for the annular exhaust channel is provided by an inwardly projecting flange on the fixed plate (a light-alloy die-casting) which encloses the transmission; this flange has a close running clearance around the outside of the brake drum. A collector recess for the exhaust gases on the inside of the fixed plate terminates in a short exhaust stub. Radial slots are provided in the fixed plate for the ingress of cooling air. This fixed plate is clamped on the spindle and located on the left-hand chainstay by an adjustable torque block.

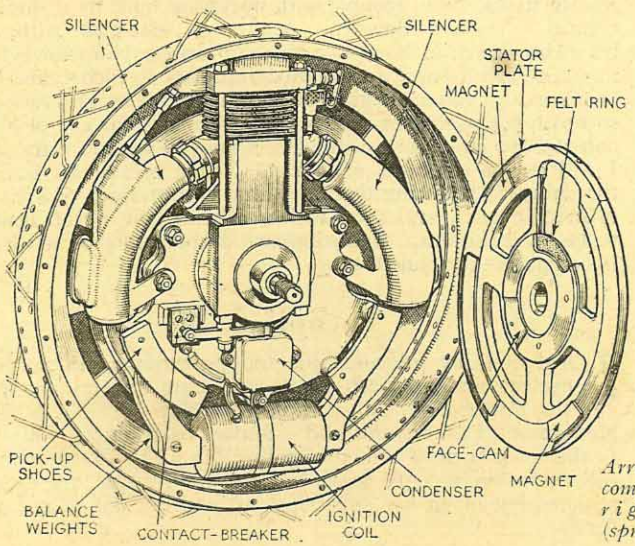


How gas expansion and piston thrust rotate the engine around the fixed crankshaft

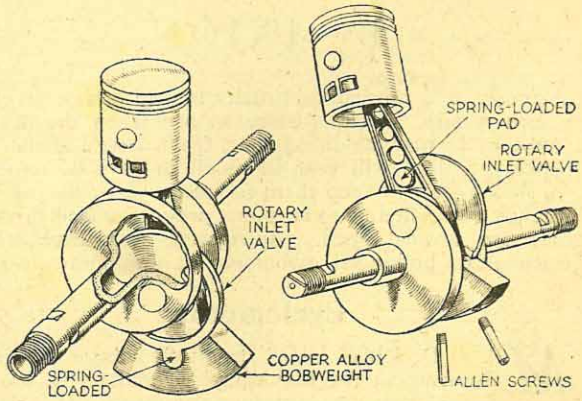
Balanced Dynamically

The unit comprising the cylinder, crankcase and ignition coil assembly rotates on two ball races around the fixed crankshaft. This assembly is balanced dynamically. The weight of the cylinder-head, barrel and silencers is counter-balanced by the ignition coil and its pole or pick-up shoes, which are bolted to the crankcase diametrically opposite the cylinder.

Similarly, the piston and connecting-rod assembly is dynamically balanced



Arrangement of engine components viewed from right-hand side (sprocket plate removed)



Details of the rotary disc valve. Note hollow left-hand mainshaft, connecting-rod bobweight, and piston transfer ports

about the crankpin; their weight is counter-balanced by a bobweight attached to the "underside" of the big-end eye.

Viewed as two separate units, therefore, these assemblies rotate about their respective axes in, it is claimed, perfect dynamic balance, and the operation of the engine is said to be virtually vibrationless.

Since the rotating engine acts in much the same way as the impeller of a centrifugal pump, its cooling is simple. Air is drawn through the radial slots in the side-plates and is centrifuged to the periphery of the drum, where it escapes radially through the outlet holes. Cooling therefore takes place whenever the engine is running, even with the cycle stationary.

With the clutch engaged the relative air speed of the cylinder head is approximately five times as high as the road speed of the cycle. It is stated that the temperature of the cylinder head does not rise above a maximum of 180 degrees Centigrade.

A further point of interest is that since approximately 90 per cent of the engine weight revolves, a beneficial flywheel effect is provided.

Light-alloy Crankcase

Details of the engine are as follows: Both mainshafts, of approximately $\frac{3}{8}$in diameter, are forged integrally with their circular crankwebs and are provided with flats for fitting to all standard cycle rear fork-ends. Each half of the die-cast light-alloy crankcase is recessed to accept the circular crankweb, and cut away to accommodate the sweep of the connecting-rod bobweight. The crankcase is supported on two ball races (one on each shaft), outside which are two spring-loaded, synthetic-rubber gas seals.

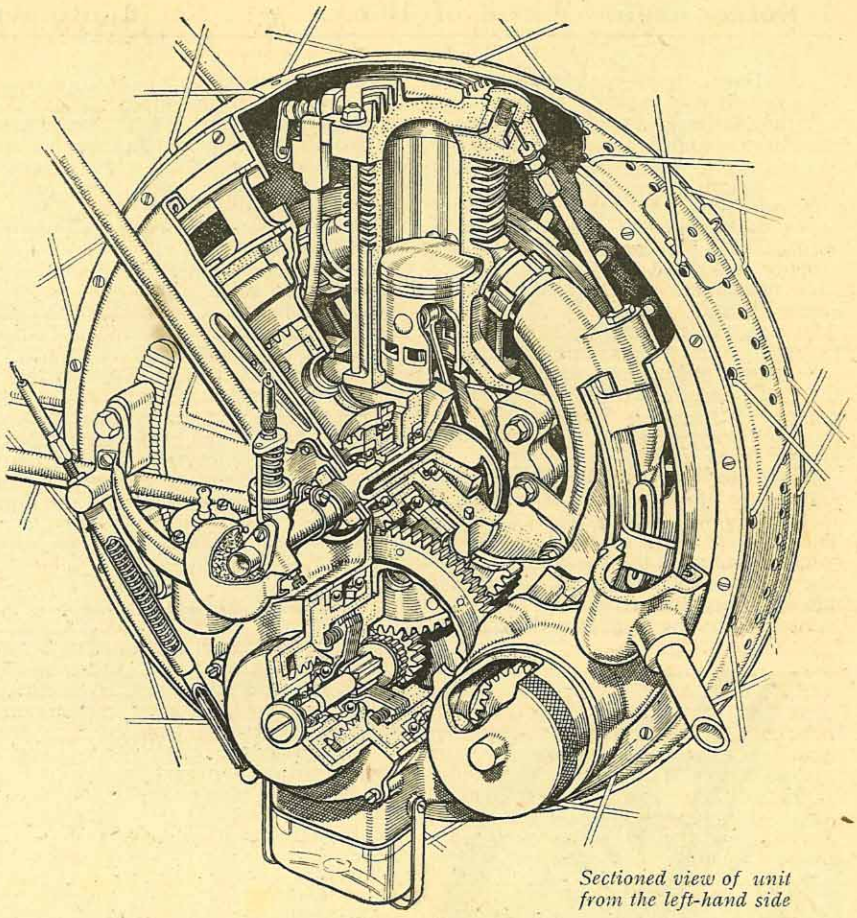
A $\frac{5}{8}$in diameter parallel-fitting crankpin is jig-pressed into the crankwebs and supports the steel connecting-rod on a crowded race of sixteen $\frac{1}{8} \times \frac{1}{4}$in rollers. Fully floating, and fitted with pressed-in light-alloy end-pads, the gudgeon pin carries a flat-top aluminium-alloy piston provided with two $\frac{1}{16}$in pegged piston rings.

Of cast iron, the cylinder barrel (bore $1\frac{1}{2}$in, stroke $1\frac{3}{8}$in) has two opposed pairs of transfer flutes which line up with two pairs of ports in the piston skirt.

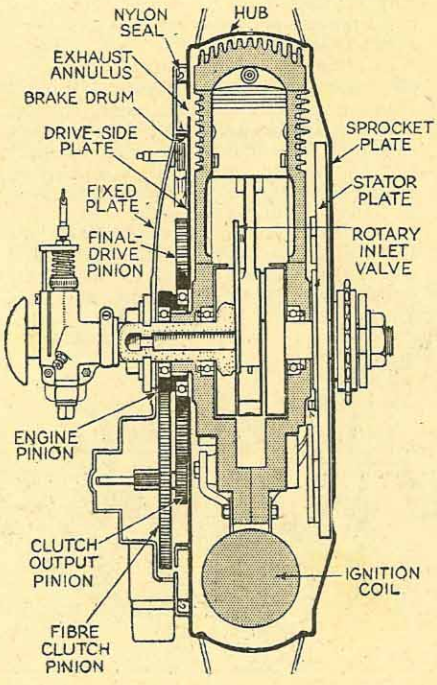
Annular Channel

Fore and aft are two exhaust ports, to which are attached two curved aluminium silencers by means of right- and left-hand threaded brass nuts; the gas seals are effected by copper-asbestos rings. The slotted outlets of these silencers discharge the gases into an annular channel in the drive side-plate, whence they pass through wide slots to the sealed annular exhaust chamber outside the plate.

The detachable cylinder head is of light-alloy and makes a ground joint with the barrel. Four long, square-head 2B.A. bolts in 50-ton steel run upward from below the crankcase main bearings and clamp both head and barrel in position by means of four nuts. A 10mm sparking plug is screwed in the front of the head at a slight upward angle from the horizontal; thus any malignant oil drops are centrifuged away from the plug points.



Sectioned view of unit from the left-hand side



Vertical section through the Power Wheel unit

At the rear of the head is an ingenious compression-release valve which communicates via a pipe with the rear silencer. When the engine is stationary, this valve is held *open* by a light spring; the valve is closed by centrifugal force when the rotational speed of the engine is equivalent to a road speed of $2\frac{1}{2}$ m.p.h. Thus, when starting, the engine does not have to be pedalled over compression; furthermore any "drain" oil in the engine is discharged through the valve before it closes.

Rotary Inlet Valve

Induction is through the hollow left-hand mainshaft via a rotary inlet valve. A flat, circular, brass disc containing a slotted inlet port is carried on the crankpin on the left of the connecting-rod. A small projecting tongue on the periphery of the disc engages with a corresponding recess in the connecting-rod bobweight; hence the connecting-rod drives the disc around the crankpin. The disc is lightly pressed against the inner face of the crankweb by two springs, one beneath the driving tongue and the other located in the connecting rod.

Clipped to the end of the hollow mainshaft is a special Amal needle-jet carburettor with adjustable slow-running

A Rotary-engine Wheel of 40 c.c. . . . Continued

stop. The carburettor incorporates an automatic choke operated by the twistgrip throttle control. To start the engine, the throttle is opened fully and a spring-loaded trigger on the twistgrip is depressed by the thumb. This permits the twistgrip to be rotated farther when the outer casing of the throttle cable depresses a spring-loaded plunger on top of the carburettor, and this action lowers the choke slide (which has a calibrated air hole) across the inlet passage.

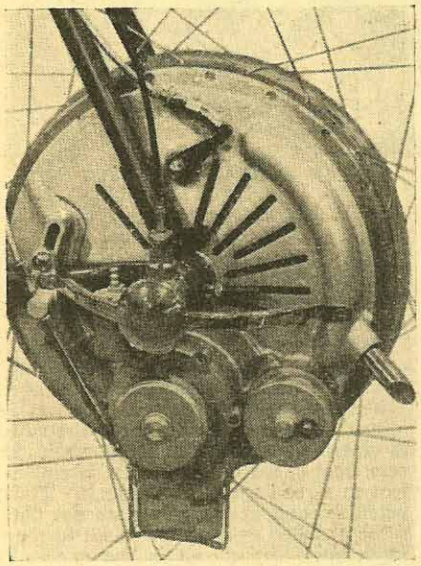
As soon as the engine is warm, the twistgrip is closed beyond the trigger position when the choke slide returns to the "off" and the throttle is operated in the normal manner. Shielding the carburettor intake is a guard which incorporates an air filter.

Keyed to the right-hand mainshaft adjacent to the crankcase is a circular stator plate with two magnets inserted. The pick-up shoes of the ignition coil (which is bolted to the base of the crankcase) have a small running clearance from this stationary magnet plate.

Mounted on the crankcase, the contact-breaker is operated by a face-cam screwed to the centre of the magnet plate. An oil-impregnated felt ring sandwiched between cam and plate lubricates the cam via a drilled hole. The h.t. lead is carried in a Tufnol guide block bolted to the crankcase and cylinder head, and a pivoted contact blade connects with the sparking plug.

Engine lubrication is by petroil, with a ratio of 25 to 1.

Splined to a boss on the left-hand side of the crankcase, the engine pinion drives a fibre-tooth gear to which is screwed the clutch body. This latter runs on two large adjustable ball races in the clutch housing in the fixed plate. Three bonded fabric and two steel plates, pressed together by four springs, transmit the drive to the clutch output pinion, which runs in needle rollers in the input gear and meshes with the final-drive pinion on the hub drum. Overall reduction is approximately 14 to 1.



This photograph shows the neat appearance of the Power Wheel when installed in a pedal-cycle

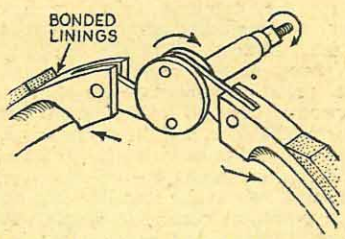
Free to be Pedalled

Clutch withdrawal is affected by a two-start quick-thread worm, operating the thrust plate via a ball race. A telescopic spring unit on the control cable returns the clutch operating arm.

If desired, the clutch output pinion may be withdrawn from engagement with the final-drive pinion, leaving the engine and transmission stationary and the machine free to be pedalled as a normal cycle. This is effected by pulling outward a knurled cap on the clutch housing cover-plate, which is clamped via a small journal ball race to the outer end of the output pinion shaft. The cap is located in its normal and emergency positions by a spring-loaded ball.

Lubrication of the transmission is by oil from the exhaust gases. This oil drains over the gears and passes by way of a slot in the fixed plate to a Perspex container attached to its base. Ninety per cent of the engine oil is said to be reclaimed in this way. The container is, of course, readily detachable.

Designed to run in oil, the brake linings are bonded to the die-cast light-alloy shoes; the fulcrum pins of the latter are screwed into the fixed plate on either side of the clutch housing. The brake-operating spindle is positively connected to the shoes by two links and pins, thus when the control is released, the spindle pulls the shoes to the off position under the action of a volute return spring threaded over the operating cable.



Brake shoes operated by links and pins

Housed in the fixed plate and gear driven from the fibre clutch pinion is a 6-volt 3¼-watt multi-pole A.C. generator for lighting. Its gear is eccentric with the generator housing, and the drive can be disengaged by a 180-degree turn of a knurled cap. Change-over to the parking battery is effected automatically by a centrifugal switch.

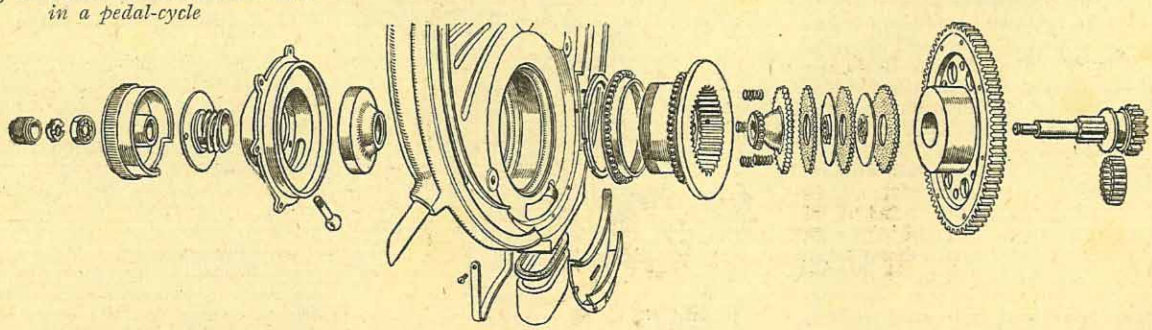
Petroil is carried in a half-gallon tank that follows the fore-and-aft curve of the rear mudguard; thus two "sumps" are formed at the bottom of the tank. The tap is fitted to the forward sump, and the rear one forms a reserve. When necessary, fuel is transferred to the forward sump by the simple expedient of lifting the rear wheel.

Addition of 18 lb

The air vent in the filler cap can be screwed down to prevent leakage should it be desired to turn the machine upside down for puncture repair. The tank incorporates a rear number plate and luggage grid.

Total weight of the assembly is 23lb, which represents an addition of approximately 18lb to a normal touring cycle. The engine is said to develop 0.5 h.p. at 2,500 r.p.m. and 0.7 h.p. at 3,600 r.p.m. Fuel consumption of approximately 250 m.p.g. is claimed.

It is proposed to set aside a factory solely for the manufacture of the Power Wheel, and to institute a nation-wide maintenance service. Manufacturers are Tube Investments, Ltd., Rocky Lane, Aston, Birmingham, 6.



Exploded view of clutch unit. Note the large fibre-tooth input gear, output pinion with needle rollers, alternate steel and fabric friction plates, and the clutch body with two large supporting ball races. On the right will be seen the quick-thread operating mechanism and the knurled cap for emergency withdrawal of the clutch output pinion

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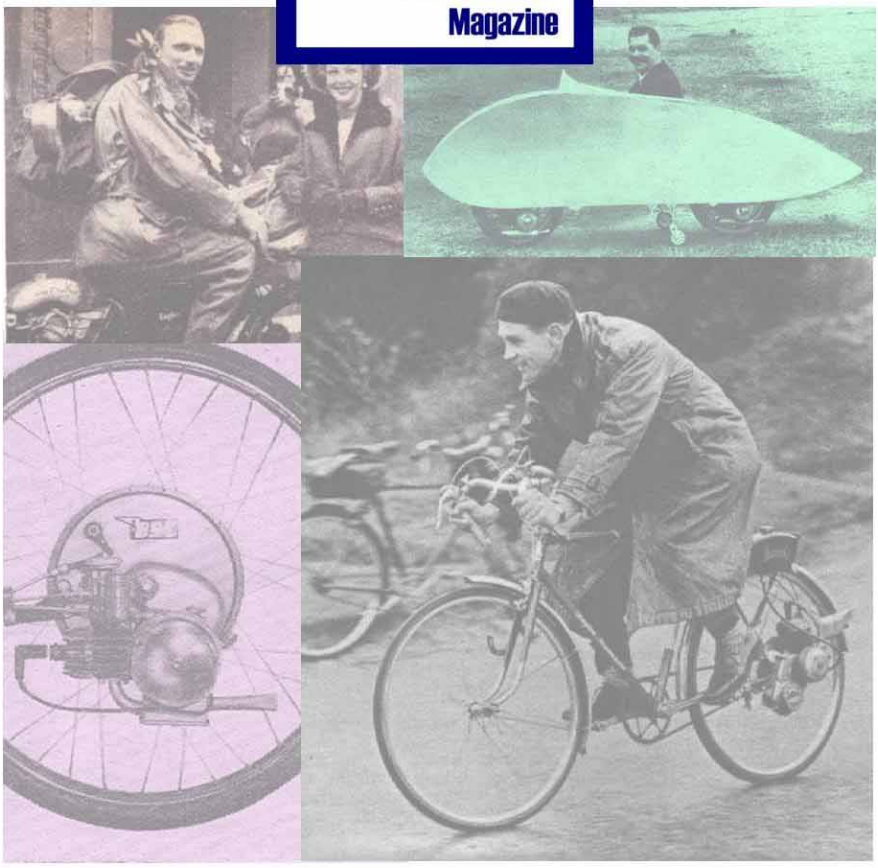

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