In the Firing Line

For something like fifty years, a magneto was as much a part of the average motor cycle as was a carburettor or an exhaust pipe. It was the magneto that overcame all the shortcomings of the early ignition systems, which invariably relied on a battery as a means of energising the engine's ignition circuit.

Early batteries were of frail construction and unable to withstand the road shocks transmitted to them by the spindly, bicycle-type frames that had little or no form of suspension. Furthermore, there was no means of charging the battery while it was on the machine. Sooner or later the battery would run down, and when it did, the machine stopped and would go no further.

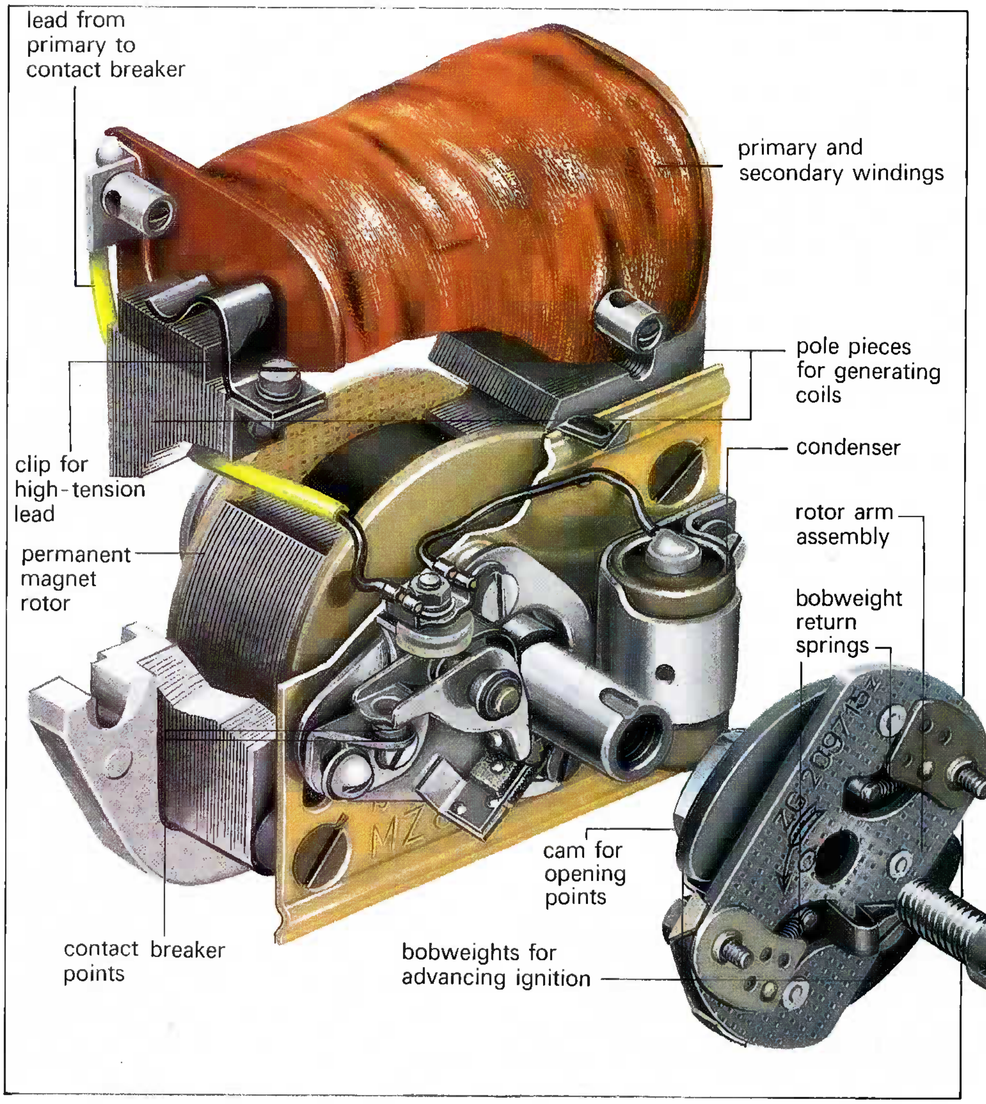
The evolution of a self-generating ignition source, driven from the engine but requiring no battery or other means of energising, opened a new era for motor cyclists – and provided a significant step forward in terms of machine reliability and efficiency.

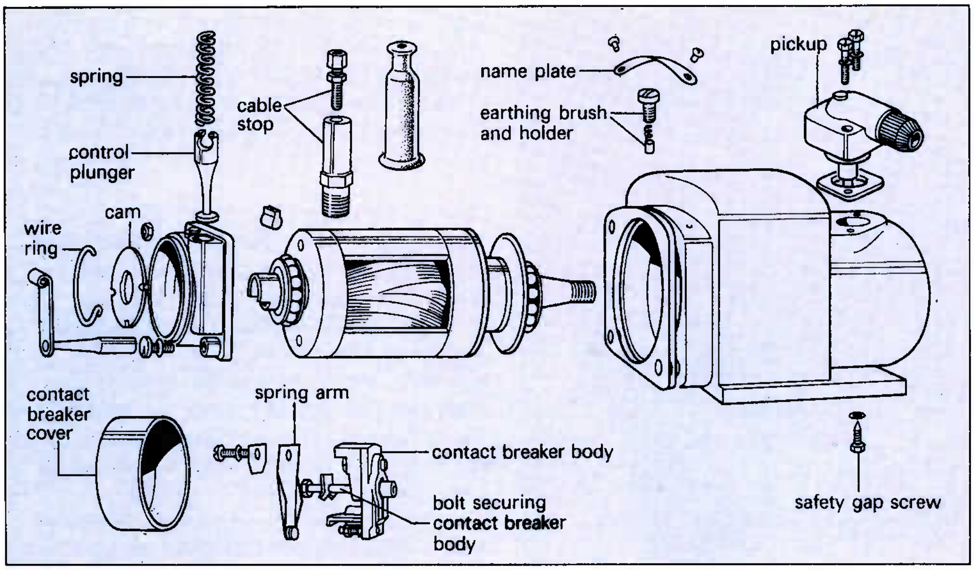
By far the most popular magneto was the German-made Bosch, which gave a very good spark even at low engine speeds; most manufacturers included the Bosch magneto in their catalogue specifications. However, when Britain declared war on Germany during 1914, an immediate problem arose, as Bosch magnetos were no longer available. Initially, British manufacturers had to resort to either the Dixie or the Splitdorf magneto, both of American origin, until some of our leading electrical equipment manufacturers got to work and came up with their own designs.

Essentially, the high tension magneto comprises a set of electrical windings, known as the armature, arranged to rotate between the poles of a horseshoe magnet, being driven from the engine by either a chain or gear pinions. By having two separate sets of windings on the armature, a primary winding and a secondary winding, it is possible to make use of the electric current that is generated in the windings as they cut the lines of force that flow between the two poles of the magnet. If a contact breaker is incorporated in the primary circuit and arranged to break the continuity of the circuit when the magnetic influence or flux is at its highest, an even greater current is developed in the secondary circuit as the lines of electric force collapse.

Because this secondary current takes the form of a very high voltage, it can be led away to the sparking plug, where the voltage is high enough to leap the air gap between the electrodes and generate the spark required to fire the mixture of air and petrol vapour in the cylinder of the engine. It follows, of course, that the spark must be arranged to occur at exactly the right moment during the operating cycle of the engine. For this reason, a magneto is driven at engine speed in the case of a two-stroke engine, and at half engine speed where the engine is of the four-stroke type. The take-off of the high tension current is by means of a slip ring attached to the end of the armature and a carbon pick-up brush. It is comparatively easy to arrange for a twin cylinder engine by modifying the slip ring and incorporating an extra pick-up brush. The only important factor, which must be known, is the direction of rotation of the armature, since the best spark will occur only when the primary current is interrupted at the moment of greatest magnetic intensity.

Early magnetos are characterised by their size, since it was necessary to use large horseshoe magnets so that sufficient residual magnetism was available to create a good spark at low engine speeds. Both heat and vibration can gradually destroy a magnet, so it was important to use as good a magnet as possible. At normal kickstarting speeds, the rate of engine turnover is quite low and many artificial factors can affect the ease with which an engine will start, even if the magneto itself is in first class condition. Cold weather, gummy oils and even the physical strength of the rider may all mitigate against turning the engine over fast enough to obtain a good spark. Never too serious a problem, it was one that improved significantly as modern technology advanced. For example, the use of more modern materials enabled the magneto to become a much more compact unit without any loss of residual magnetism, while better insulators ensured even less chance of an electrical breakdown – or that mysterious





Facing page: a cutaway drawing of a Bosch magneto and contact breaker assembly of the type used on BMWs between 1951 and 1959. This type of magneto was fitted to all plunger fork models until 1955 and then on the Earles type fork twins until 1969

Left: the components of a Lucas single cylinder type magneto, again showing the contact breaker and cam assembly, which is an integral part of the unit

Below left: a partially dismantled Villiers flywheel magneto, showing the unit's impressive simplicity of design. The flywheel (left) carries the magnets and the armature is fixed on a plate mounted on the crankcase. The assembly also incorporates lighting coils

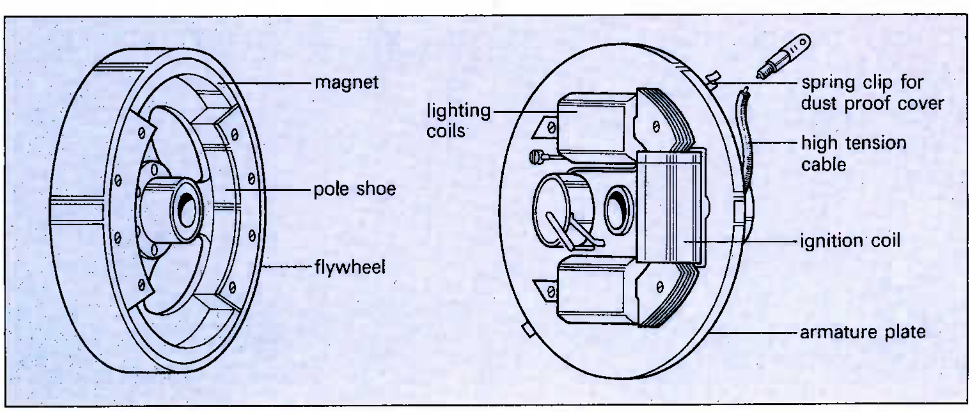
affliction known as 'shellactitis'. Early armatures were coated with shellac, a compound that will gradually absorb water vapour from the atmosphere and soften. Eventually the stage is reached where the armature will fling its shellac coating whilst it is rotating, so that when the engine cools down, the armature will seize solid in its housing. Most vintage enthusiasts will have struck this trouble at one time or another, and have been thankful for the modern epoxy resins that today have replaced the shellac coating of the old days.

Not every magneto has rotating windings, with all their inherent disadvantages. As far back as 1914, the American-made Dixie magneto had the magnet revolve between the stationary windings – a complete reversal of the normally accepted mode of operation. More recently, Lucas employed a somewhat similar technique, on both their racing and standard magneto designs. In this latter case, a change in design was made necessary because increasing engine speeds were giving rise to problems with rotating windings which, taken to an extreme, could cause a magneto to run out of breath. It was at this stage that serious thought had to be given to coil ignition as an alternative, which led to the gradual phasing out of the magneto during the late 'fifties.

So far, no mention has been made of the flywheel magneto, an alternative form of ignition that proved especially popular on most lightweight two-stroke motor cycles.

Also a self-generating instrument, the flywheel magneto took the form of a solid brass flywheel mounted on the end of the engine crankshaft, with a ring of magnets around the inside circumference. In close proximity to the magnets, but attached to a circular plate bolted to the engine crankcase, was one, two or perhaps three separate coils, which remained fixed in position. One of these coils was the ignition coil, the other one or two coils being the so-called lighting coils that supplied current for the lighting equipment of the machine. By far the most famous of this type of magneto is the Villiers Flywheel Magneto, fitted to almost every Villiers two-stroke motor cycle engine.

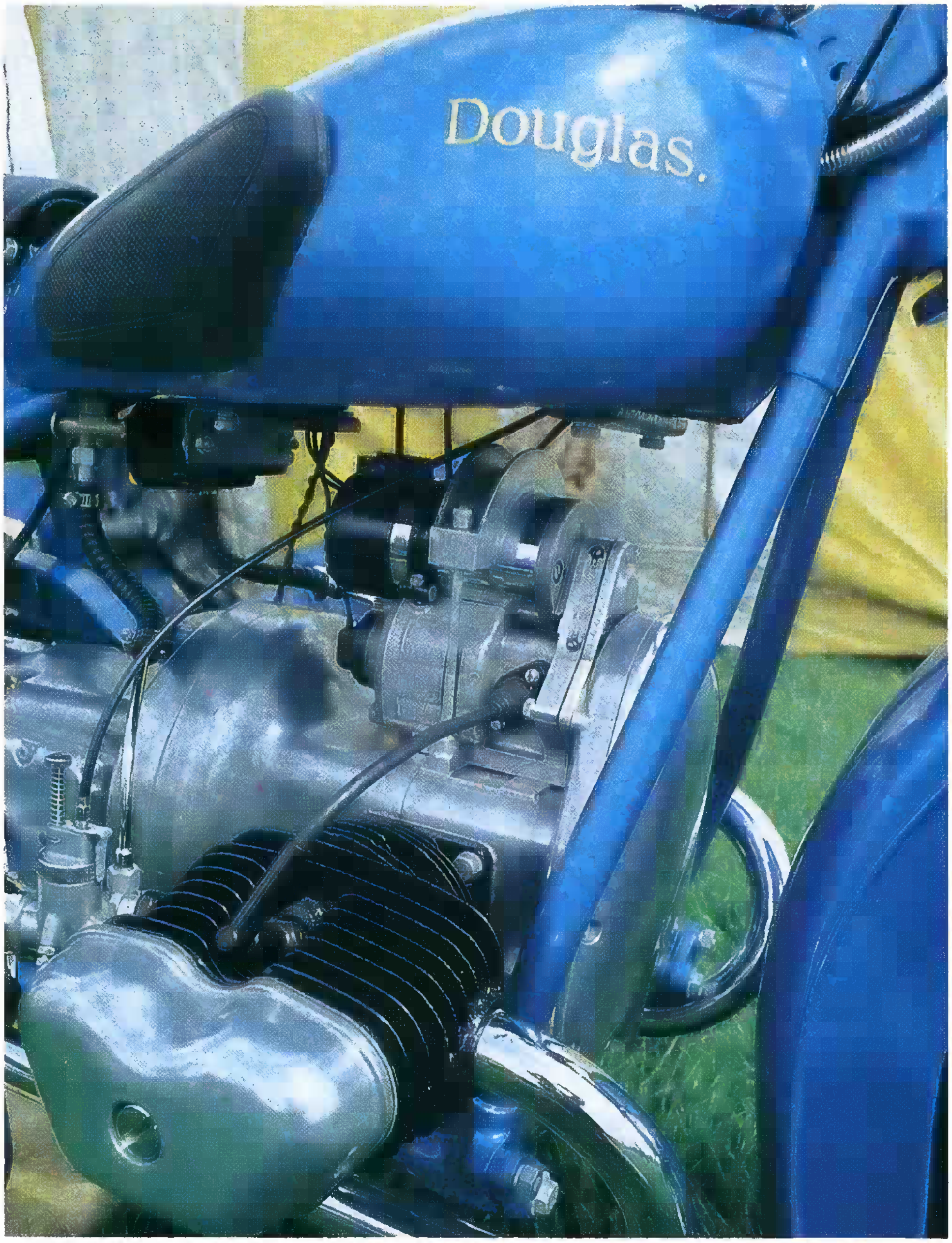
For many years it was a distinguishing feature of the Villiers engine, being identified by the pressed aluminium alloy cover on the right-hand side of the engine unit that completely enclosed the revolving flywheel. In this type of layout, the all-important contact breaker assembly is mounted on the fixed baseplate and actuated by a cam on the inside boss of the flywheel. Access is available through 'windows' cut in the face of the flywheel itself to facilitate ease of operation.



Over the years, several interesting variations of the magneto have evolved, mostly as the result of the need to include some form of electric lighting with provision for keeping a battery charged while the engine is running. Best known is the Lucas 'Magdyno', a particularly compact unit in which a direct current dynamo is mounted immediately above the magneto. Drive to the dynamo is effected by means of a large diameter fibre pinion attached to the magneto drive shaft, which in turn drives a small diameter pinion on the end of the dynamo drive shaft. An ingenious slipping clutch permits the drive to be disengaged in the rare event of the dynamo seizing and the sizes of the respective pinions are such that the dynamo can provide a high enough output to keep pace with electrical demand. If necessary, the dynamo can be detached very easily, without disturbing the magneto or in any way affecting its function. BTH employed a somewhat similar arrangement with their own version of a combined instrument, known as the 'Dyno Mag'.

Two other unusual developments were the infamous 'Maglita', a self-contained unit that acted as both magneto and dynamo, and the BTH 'Sparklight' magneto, that made use of surplus current from the magneto. The former instrument had to be run at engine speed to create sufficient charging current, and this gave rise to two sparks during the four stroke cycle, one of which could set fire to the carburettor if the engine happened to kick back during the starting process!

The latter was designed primarily for single-cylinder two-strokes, where the lighting demand was low. As the magneto ran at engine speed, it was possible to take off a small amount of current from the low tension circuit and use it for lighting purposes. Neither instrument



Left: an unusual mounting position for a Lucas Magdyno, atop the crankcase of a flat-twin Douglas Mk V of 1950 vintage. The enclosed drive to the unit can be seen between the front down tubes of the frame

Below: the component parts of a Magdyno, with the generator shown as a complete unit mounted on the magneto body. The large diameter fibre pulley, and the friction washer and spring of the ingenious slipping clutch drive to the dynamo, can be seen to the right of the diagram, between the outer casing and the end cover. The contact breaker assembly can be seen at the other end of the assembly

had a very long production run as, at the best, they could barely keep pace with even the smallest of electrical lighting loads.

Coil ignition has superseded the magneto today, the latter being classified as obsolete. Even so, it is interesting to note that many of today's two-strokes still utilise a flywheel magneto, although this is usually dependent on the battery of the machine as the external energising source, and relies on a separate ignition coil or coils. One cannot help wondering, however, whether the magneto was really as outmoded as it was alleged to be, at the time when it was dropped from production. It was very efficient in action, depended on no other components for its correct functioning, and was a compact, self-contained unit. Perhaps a pointer to the future lies in the Honda four-cylinder endurance racers, which feature a magneto as part of their standard specification. It is interesting to find that such a well tried and proven instrument still receives due recognition. JRC