the crank-pin position, but is not actually used when timing. When the engine is first assembled the crankshaft is rotated clockwise looking at the magneto side until the piston reaches the predetermined position for the particular type of engine. The flywheel is then loosely fitted and rotated until the rocker-arm pad rests on the top of the cam. The contact points are now adjusted to give the correct opening of $\frac{1}{64}$ in., or 0·015 in., and having done this the flywheel is rotated clockwise until the points commence to open. The best way to ascertain this is to place a piece of cigarette paper between the points, and then rotate the flywheel until the paper can be withdrawn without tearing. The flywheel centre nut is then tightened and the wheel rotated clockwise to top dead centre. The timing marks are then stamped, one on the armature plate and the other dead opposite on the rim of flywheel. Subsequent magneto timing is then carried out by placing the marks opposite one another with the piston at top of stroke.

Types of Magnetos

Two-pole Magneto.—The Villiers flywheel magneto which was first fitted to the Mark IV engine was the two-pole pattern, and designed to provide ignition only. This magneto was known as the large type, the flywheel having an external diameter of $8\frac{1}{4}$ in.

Later, lighting coils were added to the armature-plate cheeks, the current being A.C. and fed direct to the head-lamp. The construction of this type of magneto less lighting coils is shown in Fig. 19.

With the introduction of the 147-c.c. engine, the Mark VI-C, etc., a smaller edition of the two-pole magneto was produced, the external diameter of the flywheel being 7 in. This magneto was available with or without lighting coils, the later type being illustrated in Fig. 20.

Four-pole Magneto.—During 1932 the four-pole magneto was introduced. The armature plate had two lighting coils in addition to the ignition coil, the method of fixing to the

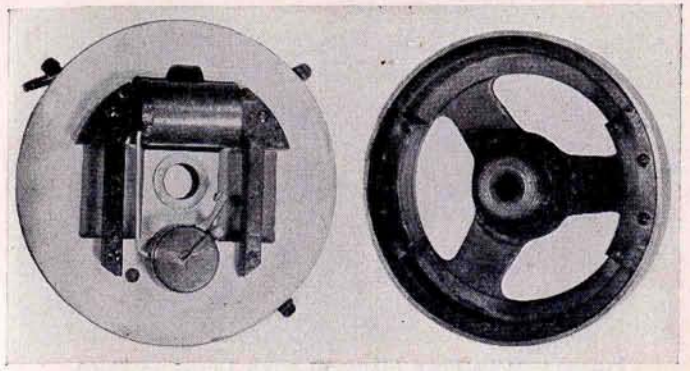

FIG. 19.—LARGE TWO-POLE MAGNETO WITHOUT LIGHTING COILS.

crankcase being either by split bush or two cheese-headed screws as described previously. The flywheel assembly is made up of four pole shoes equally spaced, the four magnets being held in position by top plates secured by the pole-shoe fixing screws. The construction of the armature plate and flywheel is clearly shown in Fig. 21.

Six-pole Magneto.—The construction of the six-pole magneto flywheel is similar to the four-pole pattern, but although six pole shoes are fitted, the number of magnets

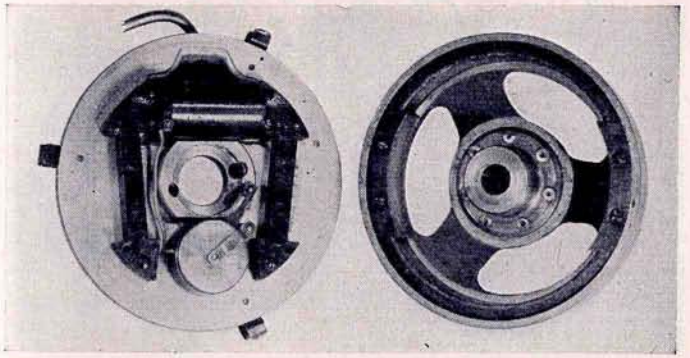

FIG. 20.—SMALL TWO-POLE MAGNETO WITHOUT LIGHTING COILS.

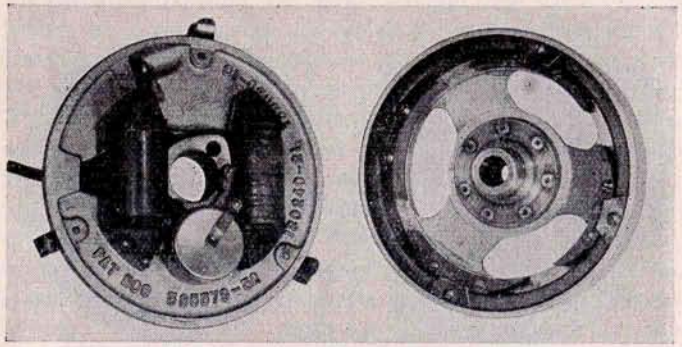

FIG. 21.—FOUR-POLE MAGNETO WITH LIGHTING COILS.

varies according to the requirements. The armature-plate assembly includes both lighting and ignition coils, and in the case of the former, separate coils for the head and tail lamps are fitted, the lighting cable from the magneto consisting of twin leads, coloured red and black.

To the leads are attached similarly coloured rubber-covered connectors, the red one being the head circuit and the black for the tail circuit, the two circuits being entirely independent. There are in service a number of six-pole magnetos having head coils only, in which case a single output lead is fitted.

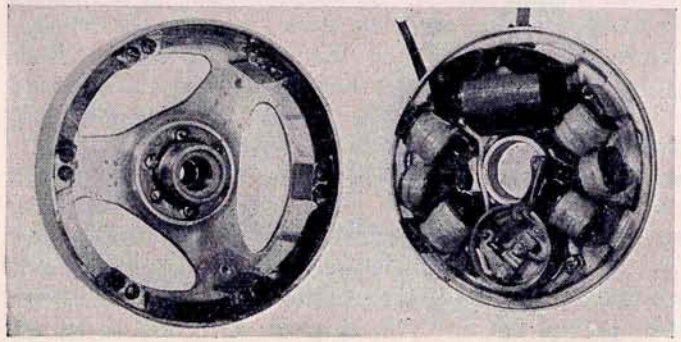

FIG. 22.—SIX-POLE MAGNETO WITH LIGHTING COILS.

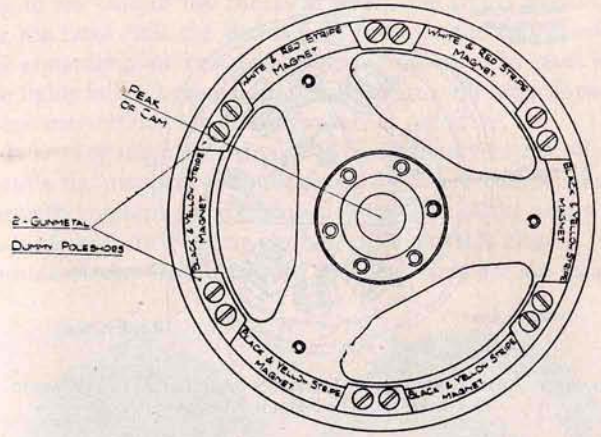

FIG. 23.—FLYWHEEL ASSEMBLY OF SIX-POLE 18-WATT MAGNETO.

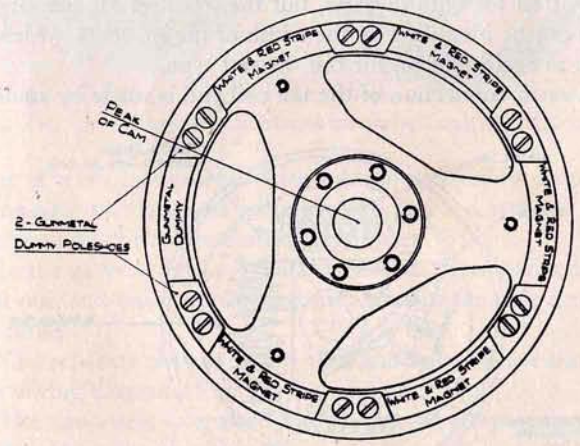

FIG. 24.—FLYWHEEL ASSEMBLY OF SIX-POLE 24-WATT MAGNETO.

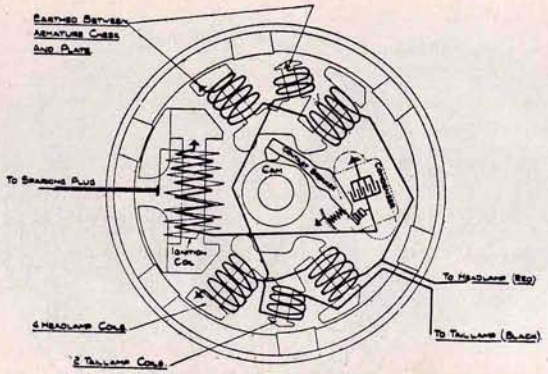

FIG. 25.—ARMATURE PLATE IGNITION AND LIGHTING WIRING DIAGRAM FOR SIX-POLE MAGNETO.

Magnetos are available giving A.C. lighting current of either 18 or 24 watts at 6 volts from the head coils, the output from the tail coils being 6 watts at 6 volts. The armature assemblies are identical for both outputs, but the flywheel for the larger output can be identified by the width of the magnets, which is $1\frac{7}{16}$ in. as against $1\frac{1}{8}$ in. for the 18-watt type.

The earth connection of the tail coil end is made by soldering to the side of the cheek on which the coil is wound, and for the head coils the end is held between the coil cheek and the armature plate by the cheek-fixing screws. In cases where the lights fail or become dim, examination will often show that these connections are either broken or defective.

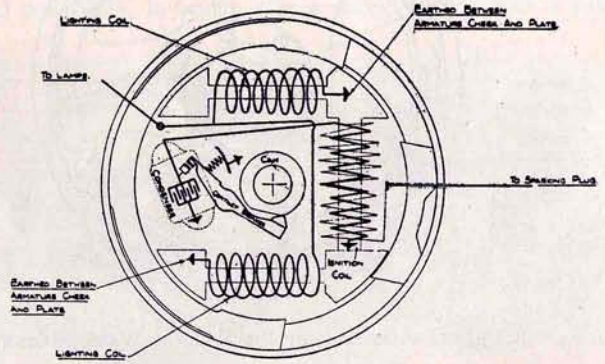

FIG. 26.—ARMATURE PLATE IGNITION AND LIGHTING WIRING DIAGRAM FOR THREE-POLE MAGNETO.

It is very important should it be necessary to entirely dismantle the magnets and pole shoes that these components are correctly reassembled in relation to the peak of the centre cam, and reference to Figs. 23 and 24 will make this clear. It will be noticed that in the 18-watt flywheel there are six magnets,

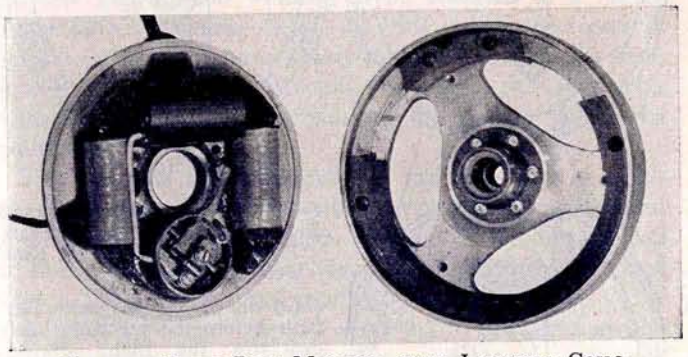

FIG. 27.—THREE-POLE MAGNETO WITH LIGHTING COILS.

four of which are painted with a black and yellow stripe, the remaining two magnets having white and red stripes. Note the position of the two dummy pole shoes.

In the 24-watt flywheel there are five magnets, painted white and red, and one dummy magnet. Two of the pole shoes are dummies.

The separate circuits of the head and tail coils are shown in the wiring diagram, Fig. 25.

The condenser-box assembly fitted to all six-pole magnetos is the old type as shown in Fig. 15 on page 48.

New Six-pole Magneto.—For the new range of engines introduced at the end of 1948 entirely new six-pole magnetos are fitted. The construction of the flywheel is somewhat

similar to the one shown in Fig. 22, page 56, but the armature-plate assembly is entirely different. A much greater output in lighting current is given which enables a 30-watt headlamp bulb to be used with the *direct* lighting set for the Mark

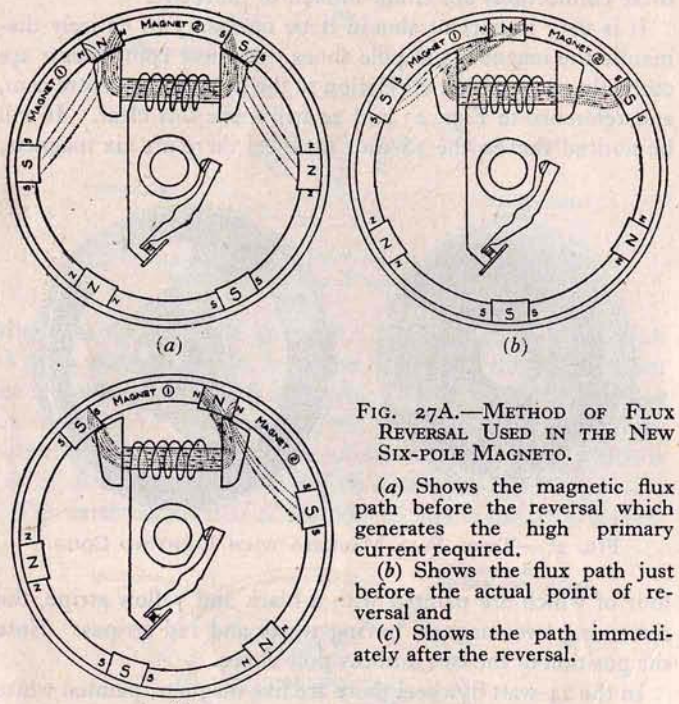

FIG. 27A.—METHOD OF FLUX REVERSAL USED IN THE NEW SIX-POLE MAGNETO.

(*a*) Shows the magnetic flux path before the reversal which generates the high primary current required.
(*b*) Shows the flux path just before the actual point of reversal and
(*c*) Shows the path immediately after the reversal.

10D and Mark 6E engine–gear units described in later chapters.

At the beginning of this chapter, the method of producing the electric spark is explained, and the method of flux reversal used in the new six-pole magneto for obtaining the high primary current required is shown in the three diagrams, Fig. 27A. In (*a*) the flux from magnet 2 is seen to be passing through the coil core from left to right, and being more or less

unchanging is generating no current in the primary winding. In (*b*) the flux of magnets 1 and 2 is seen to be drawn out to breaking point at the left-hand coil end. In (*c*) we see where the flux has broken away from the attraction of the iron mass of the left-hand coil end and jumped with extreme rapidity to the iron right-hand coil end, where it passes through the coil core from right to left.

The rapid movement of the flux across the primary wires thus generates a high voltage in the primary winding, making a powerful electro-magnet of the ignition coil and causing the fine high-tension winding to be enclosed in a highly concentrated magnetic field. At this point the contact-breaker opens and causes a very rapid collapse of this field, generating in this fine secondary winding the very high voltage required to jump the points of the sparking plug in the cylinder.

This magneto comprises rotating magnets fixed in a fly-wheel, and the coil and contact-breaker mechanism are secured to a stationary aluminium plate, and the fine windings of coil do not, therefore, have to withstand the effect of centrifugal force. The stationary coil enables a direct connection to the plug wire to be made instead of having to provide a carbon brush and slip ring, as with a rotating armature. All parts are very robust, and the flywheel is secured to the crankshaft so that there is no possibility of wear or noise which is present when a chain or gear drive is used.

The number of magnets in the flywheel and the lighting-coil assemblies vary according to the engine to which the magneto is fitted, and details are given in the chapters dealing with each model.

The condenser-box assembly for the new six-pole magneto is as illustrated in Fig. 16, needing only a screwdriver for point adjustment. It should be noted that the rocker arm itself is earthed, but that every care must be taken to see that the adjustable point plate is properly protected from the contact-breaker box itself, by: (1) the large circular insulating washer under the plate; (2) the small insulating washer under the

clamp screw brass washer; (3) the small black insulating bush in which the point plate pivots.

Three-pole Magneto.—This type of magneto providing both ignition and lighting is fitted to the Junior-de-Luxe autocycle engine, and, being mounted on the driving or near side of engine, the direction of rotation is anti-clockwise. A single lead from the magneto conveys the A.C. current direct to the

MAGNETO SPARK TIMING

Engine.	Capacity, c.c.	Timing in ins.
Midget	98	11/64
Junior	98	7/32
Junior-de-Luxe	98	1/4
Mk. VIII-D	125	5/16
Mk. 9D	125	5/16
Mk. VI-C	147	5/32
Mk. VII-C	147	7/32
Mk. VIII-C	147	1/4
Mk. XII-C	148	1/4
Mk. XV-C	148	7/32
Sports	172	5/16
Super Sports	172	11/32
S.S.T.T.	172	11/32
196 Super Sports	196	5/16
Mk. 1E	196	7/32
Mk. 2E	196	7/32
Mk. 3E	196	3/8
Mk. VI-A	247	3/16
Mk. IX-A	247	5/16
Mk. X-A	247	5/16
Mk. XVI-A	247	5/16
Mk. XIV-A	249	3/8
Mk. XVII-A	249	7/16
Mk. XVIII-A	249	7/16
Mk. IX-B	342	5/16
Mk. IX-BA	342	5/16
Mk. X-B	342	5/16
Mk. XIV-B	346	3/8
Mk. 1F, 4F	98	1/8
Mk. 2F	98	1/8
Mk. 10D, 11D, 12D	122	5/32
Mk. 6E, 7E, 8E	196	5/32

The timing dimension is in all engines measured *before* top dead centre and, with the piston so positioned, the magneto contact points should be just about to open.

headlamp, the current for the tail lamp being controlled by the switch through a resistance so that the single-filament bulb can be fed by a dry battery for parking purposes. The new type of condenser-box assembly described on page 49, Fig. 16, is now fitted as standard, and is interchangeable with the old type as a complete assembly. A wiring diagram is shown in Fig. 26 and it should be noted that the one end of the lighting coils is earthed by being held underneath one of the coil cheeks, thus making contact with the armature-plate casting.

The assembly of the magneto components is clearly shown in Fig. 27.

The three-pole magneto as described above can be fitted to the original Junior autocycle engine, but as the output from the lighting coils is double that of the original two-pole magneto, it is necessary to change the bulbs as recommended on page 73.

SPARKING PLUG CHART

Recommended " Lodge " Types for Villiers Engines

Engine.	Capacity, c.c.	Plug.
Midget	98	C3
Junior	98	C14
Junior-de-Luxe	98	CB3
Mk. 1F, 2F and 4F	98	H14
VIIID and 9D	125	H3 or H1
10D and 12D	122	H14
11D Comp.	122	HH14 or R49
VIIIC	147	C3
XIIC	148	CB3
Sports	172	CB3
Super Sports	172	HLS
1E and 2E	197	CB3
3E	197	CB3
5E	197	HLS
6E and 8E	197	HHN or HH14
7E Comp.	197	R49 or LA11
XIVA	249	CB3
XVIIA	249	CB3
XVIII-A	249	CB3
XIV-B	346	CB3