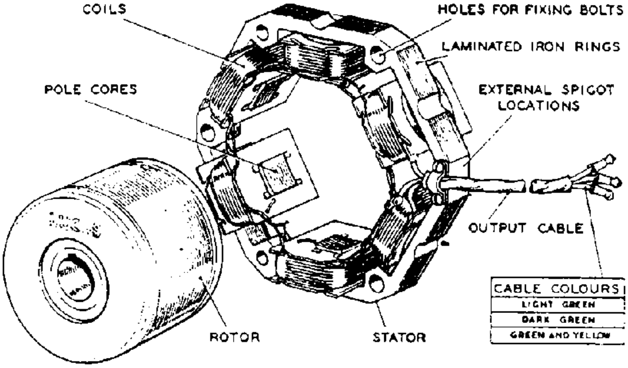


Fig. 1. The RM 13 alternator. The rotor is driven by the engine crankshaft and the stator coils are stationary.

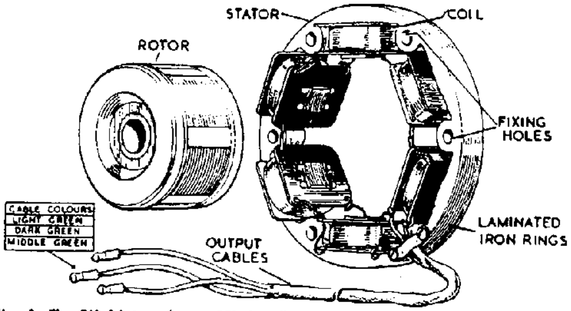


Fig. 2. The RM 14 type has a 5⅞ in. diameter and can supply a lighting circuit using 42 watt bulbs.

Principles of the LUCAS AC Lighting and Ignition Circuit

APART from minor modifications and refinements, the principle of operation of the electrical system as fitted to motorcycles has essentially been the same for many years. Even now the majority of makes are fitted with a conventional direct current generator and a voltage regulator.

In recent years however, a completely new system has been developed. Instead of a d.c. generator, this new system employs a rotating magnet alternator which is completely built-in the engine, as the source of electrical supply. In this article we will describe the well-known Lucas A.C. Lighting and Ignition system as fitted to certain B.S.A., Triumph and Royal Enfield cycles.

With this new system the Lucas firm uses a conventional coil ignition, which is simpler, cheaper and lighter than a high-tension magneto. The new igni-tion system resembles the high tension magneto in this respect that it still affords the possibility of kick starting the machine, even though the battery may be completely discharged. Figs. 1 and 2 shows the two types of alternator currently being manufactured by the Lucas Company. The model RM 13 has a 5 in. diameter and is suitable for lighting equipment not exceeding 30 watts rating. The RM 14 is the larger model, and has a 5⅞ in. diameter. This type can supply a lighting circuit using 42 watt bulbs and operates in conjunction with an 11 plate battery.

The illustrations show clearly how these alternators are constructed. The rotor has powerful permanent magnets which are keyed to each pole tip. The rotor is carried on, and driven by an extension of the engine crankshaft. The pole tips are riveted to brass side-plates and the assembly is cast in aluminum and machined to a smooth finish.

The stator is laminated and the windings consist of three pairs of coils connected in series; one pair being permanently connected into the battery charging circuit.

Fig. 3 shows how the electric current is induced in the coil windings. As can be seen from the drawing, adjacent poles have different polarity and as the rotor turns, the magnetic flux through the coil cores on the stator is reversed, so inducing an electric alternating current in the coil windings.

For every revolution of the motor, flux polarity changes 6 times. The alternating current generated by the alternator is the same kind as our home power supply and unsuitable for battery charging. Alternating current derives its name from the fact that its voltage is alternating between positive and negative values. Alternating current as we mentioned before cannot be used for battery charging, for which we need so-called direct current, which flows in one direction only.

With a conventional motorcycle generator the a.c. generated in the armature is changed to direct current by a commutator rectifier. Although this is a satisfactory method, it involves complications, such as commutator bars, insulation, brushes and brushgear. With the Lucas alternator a so-called selenium rectifier is used. A typical selenium element consists of a plate coated with selenium on one side and this device permits passage of current in one direction only.

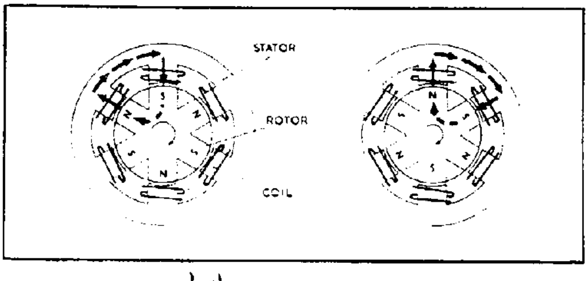
Fig. 4 shows the principle of this type of rectification. With the set-up shown however, no current can flow during the negative half of the wave and the result is so-called half-wave rectification, where the negative half of the wave is cut-off.

Although this type of wave could be used for battery charging, an appreciable amount of energy would be wasted and consequently overall efficiency would be low. Full-wave rectification with the Lucas alternator is attained by using four selenium rectifiers and connecting them in the form of the bridge shown in Fig. 5 (sometimes called a Wheatstone Bridge circuit). The battery is connected across one pair of bridge arms and the alternating current is fed to the other pair in the manner shown. Since the source of power is alternating current, the lines are alternatively positive and negative.

When the top line is positive, current flows through 1, through the battery then through 2 to the lower current wire. When the lower line is positive,

(Continued on page 32)

Fig. 3. Flux reversal in coil windings as rotor turns through 60°. Alternating current is generated in the stator coils.



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LUCAS AC IGNITION - *continued*

current flows through 3, through the battery and out through 4 to the top current wire. Note that the selenium rectifiers work as one-way valves, and that the current always flows through the battery in the same direction, and that, apart from a small efficiency-loss in the rectifier, the full wave of the alternating current is used.

Current output at 2,000 rpm is 6.0-6.5 amps for the RM 13 and 8.5-9.0 for the RM 14. The electrical characteristics of the Lucas type alternator are such that the output increases only 1.0-1.5 amps between 2,000 rpm and 5,000

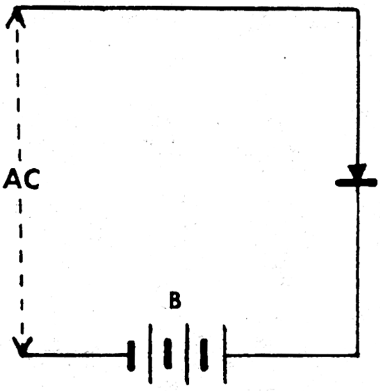


Fig. 4. Principle of rectifier for half-wave rectification (Also see illustration on bottom of page, last column).

rpm, a very great advantage for an electrical system such as used in a motorcycle.

This characteristic and the fact that the amount of current generated can be varied according to the positions of the lighting switch, makes a separate voltage regulator unnecessary.

The different switch positions alter the connections of the stator coils to meet the additional loads (headlights or parking lights). Switch positions are as follows (see Fig. 6):

Lights off: Two pairs of alternator coils are short-circuited. Through interaction of the rotor flux and the flux generated by the flow of current in the short-circuited coils, the current flowing in the third pair of coils is reduced to a minimum.

Parking lights only: The two pairs of coils previously short-circuited are now switched to open circuit which reduces the regulating fluxes. Alternator output increases and compensates for the parking light load.

Headlight switched on: In this switch position all the three coils are arranged in parallel and alternator output is further increased.

Emergency starting system

It is possible to kick-start the engine when the battery is completed discharged by switching the ignition switch to an emergency position (EMG).

The circuit used for emergency starting is shown in Fig. 6a (single-cylinder) and Fig. 6b (twin-cylinder). In these emergency starting circuits the contact breaker is arranged in such a way that it opens the circuit when the alternating current in the windings reaches a maximum in the direction shown by the feathered arrows.

In Fig. 6a (circuit for the single-cylinder), the breaker points are connected parallel across the primary winding of the ignition coil. With the contacts closed, the main return circuit is through one arm of the rectifier bridge. When the ignition points open, the built-up energy of the alternator windings quickly discharge through an alternator circuit provided by the ignition-coil primary winding. This rapid transfer of energy from alternator to coil induces a voltage in the secondary winding high enough to fire the spark plug.

Twin-cylinder machines: Fig. 6b shows that for the twins the ignition contact points are connected in the more conventional way, that is in series with the ignition coil. This arrangement permits the use of a slightly simpler switching system and cable harness.

According to the Lucas Company, the latter arrangement is unsuitable for use with single-cylinder machines due to premature "idle" sparking occurring before the ignition points open. With the twin cylinder engines fitted with a distributor this premature sparking does not occur. In the single-cylinder ignition-circuit the only possibility for "idle" sparking is after the ignition

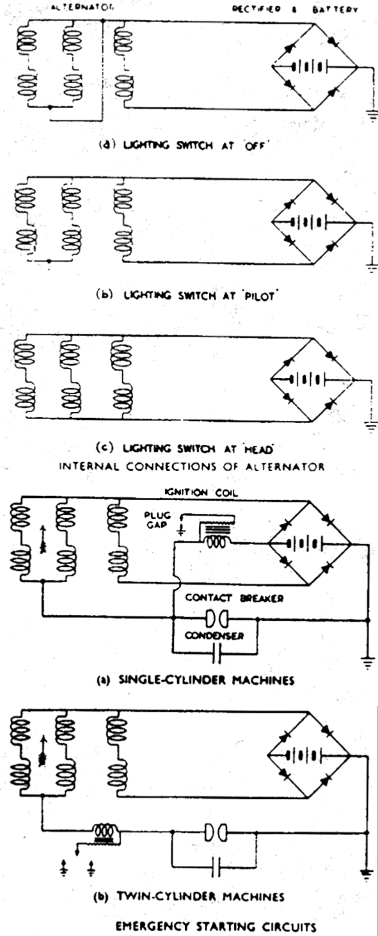


Fig. 6. Current circuits for different switch positions. Fully explained in text.

points have opened and the mixture is fired, and sparking at this stage is harmless.

With the ignition-switch in the EMG position and the engine running, the battery is being charged up and battery voltage gradually rises. Battery voltage opposed alternator voltage, and, with the single-cylinder machines, voltage available for the ignition coil will in time be reduced to such an extent that the engine starts to misfire. This is a gentle reminder to the rider to switch over from the EMG position to IGN position.

Another advantage of the new system is that short journeys can be made without battery. All one has to do, if

(Continued on page 41)

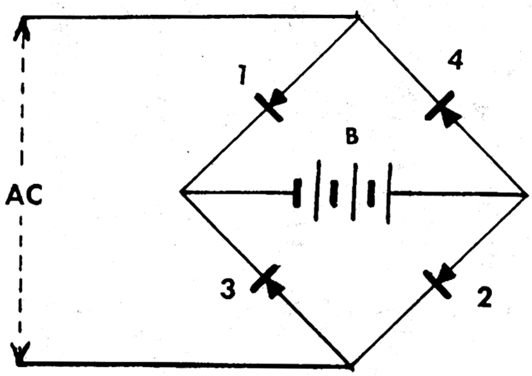
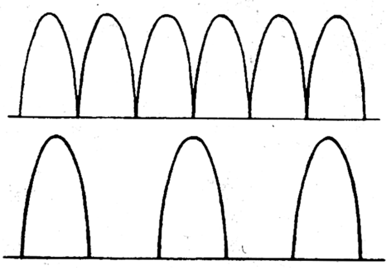


Fig. 5. Full-wave rectification is obtained by connecting four selenium rectifiers in the Bridge Circuit shown. With this arrangement the negative half of the wave is also made use of. Also see illustration on the right.



Full-wave (top) and half-wave rectification of alternating current as explained in text.

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88/3

Airport operator, Charles Hall of Lubbock, Texas, gets in some "flying time" on his Tiger Cub. He seemed never to have both wheels on the ground at once. Hall set the lap record of 47.5 seconds for the .4 mile course during practice but evidently got tired during the races and slowed down.

Scrambling down Texas Way

MARCH 20, 1955 saw the first out and out California type scrambles held in Borger, Texas, sponsored by the Canadian River Motorcycle Club. Surprisingly enough, the lightweight class had the most entries with the 30.50 and 45 in. class coming in for a close second and the two heavier classes had almost no entries whatsoever.

The course was very fast, laid out over rolling sand hills, gullies and river bed, which was conducive to much action and close competition. Spectators were kept on their feet by the fast action and hot competition in all classes.

The two lightweight heats placed Triumph Cubs in the first two places with NSU taking the third spot. The second heat was won by a Mustang with a H-D 165 second and a BSA 150 third. The runoff for lightweights was won by James Williams on a Tiger Cub, Billy Fry on a BSA was second and Charles Hall on another Cub came in third.

First Mediumweight heat placed Royal Enfield Scramblers in first and second with a H-D KR taking the third spot. Second heat was a house cleaning in all three by H-D K models. Runoff gave the first three places to Royal Enfields ridden by Carl Hart. Jim Turnbow and Jesse Mille.

The light-heavyweight class sported only three entries with Matchless mounted Burt York leading, George Mills (KHK) second and Road Rocket mounted Donald Parker third. Heavyweights were all H-D 74 with Bobby Johnson first, Bill Ramsay, second, and Coy Giles third.

The final race consisted of all placers in all classes running at once. R. E. mounted Jesse Miller of Pampa, Texas set the pace for several laps but spilled intentionally to miss a fallen rider, remounted and finished with his throttle stuck wide open in 6th place. Royal Enfield mounted Carl Hart of Lubbock, Texas took the lead and held it to the finish with Jim Turnbow, Pampa taking very close second while being pushed hard by Tiger Cub mounted James Williams of Lubbock.

1	Carl Hart	R. E. Scrambler
2	Jim Turnbow	R. E. Scrambler
3	James Williams	Tiger Cub
4	Burt York	Matchless 550 cc

LUCAS IGNITION

(Continued from page 32)

the battery should be removed or disconnected for any reason is to ground the cable normally connected to the negative battery terminal.

The advantages of the new A.C. Lighting and Ignition System over the conventional system can be summarized as follows: Because of the fact that permanent magnets are employed there are no rotating windings; there is no commutator or brush gear to wear out and the operation is completely silent. Bearings and oil seals are not used. The overall construction is simpler and lighter and a voltage-regulator is not necessary. The motorcycle can still be used even if the battery is disconnected.

Last but not least, the whole unit is compactly located in the chain case and requires no maintenance.

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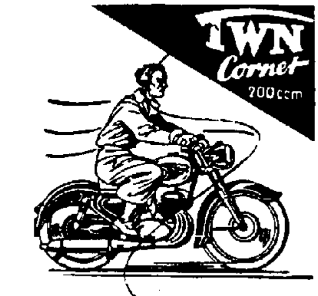

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