LUCAS

12 VOLT ZENER DIODE CHARGE CONTROL

FOR MOTOR CYCLES

the conversion of 6 volt A.C. equipment


LUCAS
KING
ROAD

The conversion of 6-volt motor-cycle equipment to 12-volt lighting and Zener Diode Charge Control

Why 12 volts?

The capacity of motor-cycle battery-charging equipment has always been limited by reasons of size and weight. Consequently, riders have felt that insufficient power has been available to enable headlamp illumination to keep pace with advances in machine performance and that the disparity between motor-cycle and car lighting has tended to increase. A further limitation has been the necessity to adopt compromise charging rates, with adjustments or special units to meet extremes of machine usage.

However, by the use of 12-volt equipment (originally introduced on machines fitted with electric starting) the position can be greatly improved, both with respect to road illumination and to battery-charging. A 12-volt system allows the use of car-size headlamp bulbs and also the new Lucas Zener Diode Charge Control of battery input, the benefits of which are described below.

Note.—At present, high-current Zener diodes can only be produced on a commercial basis for 12-volt applications.

Zener Diode Charge Control

The Lucas Zener Diode Charge Control is a simple, non-mechanical (in fact, electronic) method of regulating battery input current from your existing alternator. The control is self-regulating and so flexible in operation that the charge rate is automatically adjusted to suit such differing conditions as Continental touring in summer and the daily home–work–home journeys of winter. Provided the capacity of the alternator is not exceeded, a Zener-diode-controlled 12-volt system also allows extra current-consuming accessories to be fitted, such as an auxiliary driving lamp, twin horns, and flashing direction-indicators.

The System without Zener Diode Charge Control

As you probably know, the motor-cycle alternator comprises a six-pole permanent magnet rotor and a six-limb stator. For most applications the stator is fitted with six coils—one to each limb—and in these the alternating current is induced. The more uncontrolled coils there are in use, the more current is generated for rectification to direct current. This arrangement is shown in diagrams **(a)** to **(e)**. Usually, the rectified output from only two of the stator coils is fed into the battery for providing permanent trickle-charging —the remaining coils being brought into use by the lighting switch as required. This is shown in diagrams **(a)** to **(c)**. To have more than two coils permanently associated with the battery could, on many models, lead to overcharging. Nevertheless, the system is inherently self-controlling and has now given good service for many years.

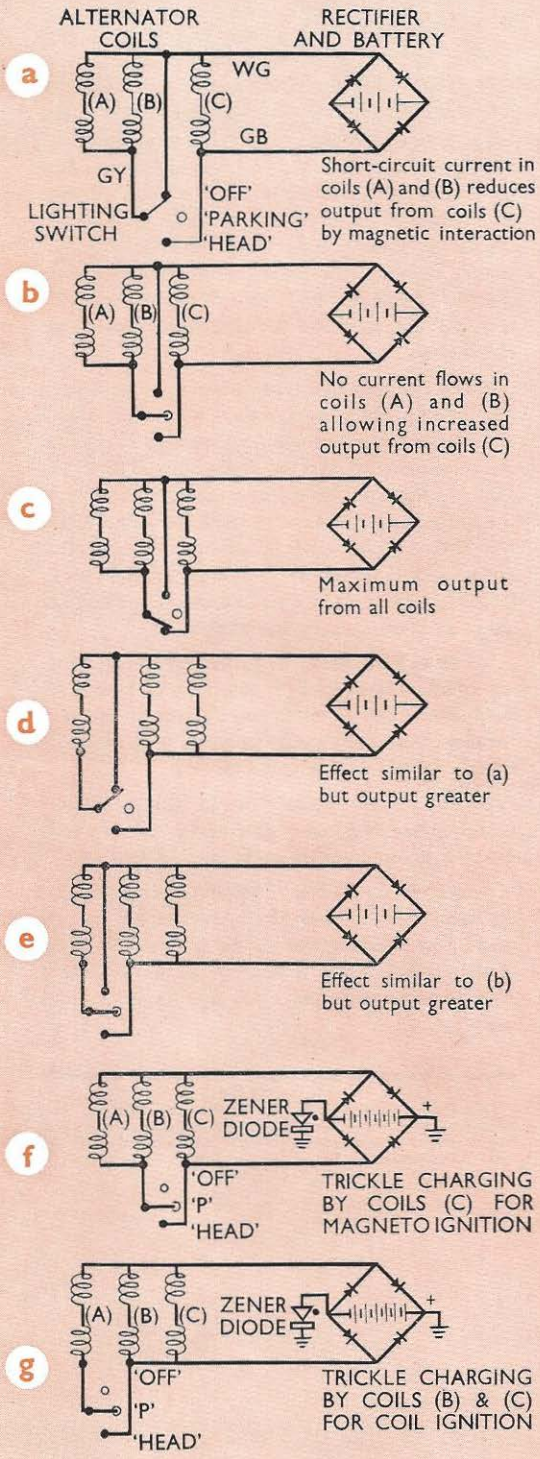
The System with Zener Diode Charge Control

Circuits incorporating a Zener diode are shown in diagrams **(f)** and **(g)** for magneto and coil ignition machines, respectively. The diode is connected in parallel with the battery and, in effect, acts as a by-pass valve through which rectified current from the alternator is directed according to the state of charge of the battery. With magneto ignition two coils are permanently associated with the battery, and with coil ignition four coils. In neither case is it now necessary to use the control shown in diagrams **(a)** and **(d)**. Instead, full output of the coils is available for Zener-diode-controlled trickle-charging in lighting switch positions 'Off' and 'P'.

Methods of obtaining alternative charge rates: (a) to (e) Without Zener Diode Charge Control; (f) and (g) With Zener Diode Cnarge Control.

Circuits (a), (b), and (c) are normally used with magneto ignition, and (a) and (c) with coil ignition. Circuits (c), (d), and/or (e) are used in radio-equipped motor-cycles (particularly machines engaged in localized slow-running patrol work involving long periods of night parking).

Circuits (c) and (f) are used with magneto ignition, and (c) and (g) with coil ignition.


ALTERNATOR COILS
RECTIFIER AND BATTERY
a
WG
(A)
(B)
(C)
GB
GY
'OFF'
'PARKING'
'HEAD'
LIGHTING SWITCH
Short-circuit current in coils (A) and (B) reduces output from coils (C) by magnetic interaction
b
(A)
(B)
(C)
No current flows in coils (A) and (B) allowing increased output from coils (C)
c
Maximum output from all coils
d
Effect similar to (a) but output greater
e
Effect similar to (b) but output greater
f
(A)
(B)
(C)
ZENER DIODE
+
'OFF'
'P'
'HEAD'
TRICKLE CHARGING BY COILS (C) FOR MAGNETO IGNITION
g
(A)
(B)
(C)
ZENER DIODE
+
'OFF'
'P'
'HEAD'
TRICKLE CHARGING BY COILS (B) & (C) FOR COIL IGNITION

As a battery becomes recharged its terminal voltage rises, and when it reaches approximately 14 volts the Zener diode, which up to this point has opposed the passage of current, becomes partially conductive and thus provides an alternative path for a small part of the alternator output. Further small rises in battery voltage result in large increases in diode conductivity until, at approximately 15 volts (the on-charge voltage of a fully charged 12-volt battery), the bulk of the alternator output is by-passed and the system off-load voltage is stabilized.

If, now, an electrical load such as the headlamp is switched on, the system voltage will fall below 15 volts and less current will flow through the diode, the balance being diverted to feed the load. In the event of the load being heavy enough to depress the system voltage below 14 volts, the Zener diode will revert to its high-resistance state of virtual non-conductivity and all of the generated output from the alternator will go to meeting the current demands of the battery and equipment.

When the headlamp is in use the conventional arrangement is retained for obtaining full alternator output whereby all three pairs of stator coils are parallel-connected through contacts in the lighting switch.

Under Zener Diode Charge Control overcharging is eliminated—the battery has an easier life and requires less frequent topping-up.

Under Zener Diode Charge Control greater utilization of available alternator output can be made, thus reducing the danger of undercharging. It also allows extra accessories such as flashing direction-indicators and a fog or spot lamp to be used.

The Zener diode is a semi-conductor device that becomes conductive in the reverse direction at a critical but predetermined voltage. It is named after the person who first predicted this phenomenon.

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WHAT YOU NEED

The equipment required to convert a 6-volt alternator-equipped motor-cycle to Zener Diode Charge Control, in addition to the diode, its heat sink, and connections, are those items designed for 12-volt operation. These are considered separately below.

Battery

A second 6-volt battery must be connected in series with the existing battery. The batteries must be of the same type and capacity.

Note.—Two MK9E batteries will fit into a PU7E carrier, thus solving the problem on many machines of accommodating the extra battery.

Rectifier

(*a*) Modern units with silicon cells—no change.

(*b*) Older units with selenium cells—advisable to change to silicon type.

Ignition

(*a*) Magneto machines—no change.

(*b*) Coil ignition machines—

(i) New ignition coil required.

(ii) On machines fitted with distributor model 18D2 or contact breaker unit 18D1 remove the small built-in capacitor and fit a larger capacitor externally.

Horn

New horn required such as high-frequency Model 8H. Alternatively, the more powerful horn, Model 6H, can be used or, for really potent signals, a pair of car-type Windtone horns, Model 9H, with blended high-note and low-note performances could be fitted.

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Headlamp

(*a*) On machines fitted with left-hand dip light units (marked 'Right-hand Drive'), replace the bulb with Lucas No. 414, 12-volt 50/40-watt.

(*b*) On machines fitted with 7 in. dia. vertical dip light units (marked 'Motor-cycle') fit bulb No. 446, 12-volt 50/40-watt.

(*c*) On machines fitted with $5\frac{3}{4}$ in. dia. vertical dip light units (marked 'Motor-cycle Lightweight') replace the bulb with Lucas No. 446.

(*d*) Replace parking light bulb with No. 222, 12-volt 4-watt.

Stop/tail lamp

New bulb required. If the bulb holder is designed to accept non-reversible bulbs use No. 380, 12-volt 6/21-watt (with indexed pins).
If reversible, use No. 381 (but be careful to insert it the correct way round).

Sidecar lamp

New bulb required. Use No. 989, 12-volt 6-watt, for Lucas Sidecar Lamp, Model 569.

Speedometer illumination

New bulb required, obtainable from Smiths Motor Accessories Ltd.

FITTING INSTRUCTIONS

If you decide that 12-volt equipment with Lucas Zener Diode Charge Control is the thing for your machine, write to us for Publication No. 2380 in which we have given full fitting instructions, diagrams, and lists of equipment to suit many models—equipment which can be obtained through motor-cycle traders and Lucas Agents everywhere.

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