Bicycle Light Backup

Keeping bicycle lights on even when you stop.

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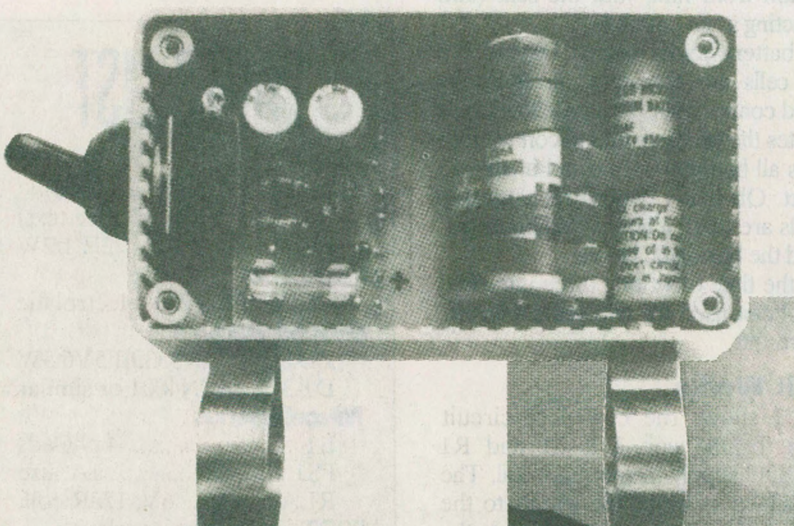


Dynamo lighting systems for bicycles suffer rather dangerously from the lack of output at a standstill, such as waiting at traffic lights or road junctions. Apart from this obvious disadvantage, dynamos compete favourably with battery- powered lights because they:

- are lighter
- require no costly battery replacement
- provide higher light output (except at low speeds)
- are far more reliable than battery-powered systems.

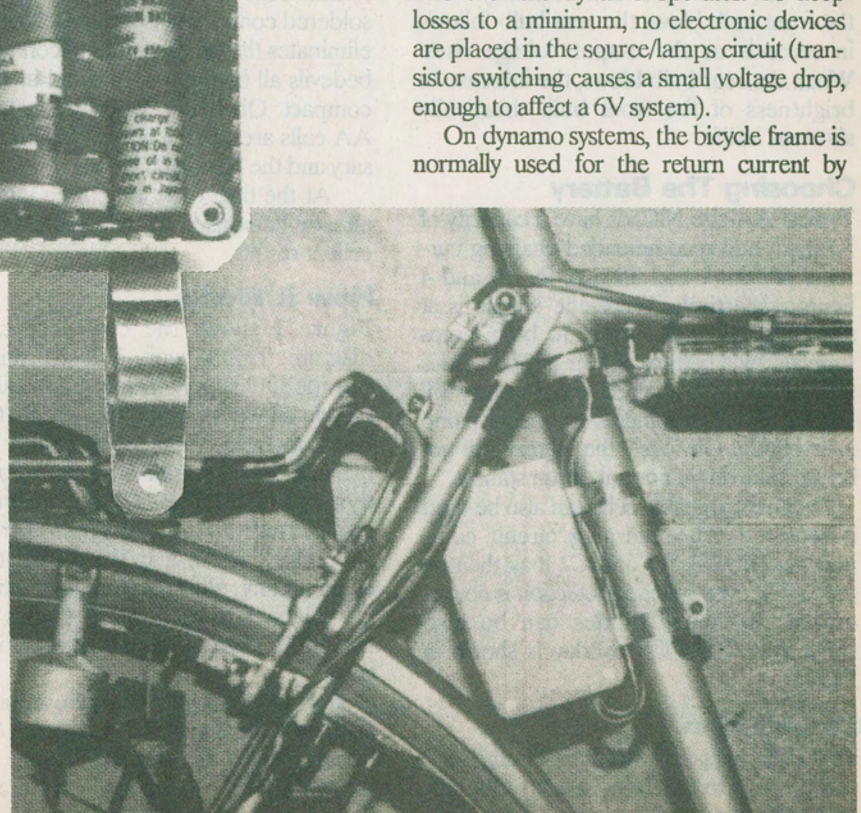
Because of the great similarity in the output characteristics of dynamos available on the market, the system described here will operate in conjunction with any dynamo set to provide safe lighting down to a standstill. The supply to the front and rear lamps is switched from the dynamo to the rechargeable batteries as the bicycle speed (and so the dynamo output voltage) falls below a predetermined value.

The unit is inexpensive, simple to make and install, and could prove to be a lifesaver.

Features

By using rechargeable batteries in the back-up unit, the need for battery replacement is eliminated. The batteries are on charge whenever the dynamo operates. To keep losses to a minimum, no electronic devices are placed in the source/lamps circuit (transistor switching causes a small voltage drop, enough to affect a 6V system).

On dynamo systems, the bicycle frame is normally used for the return current by



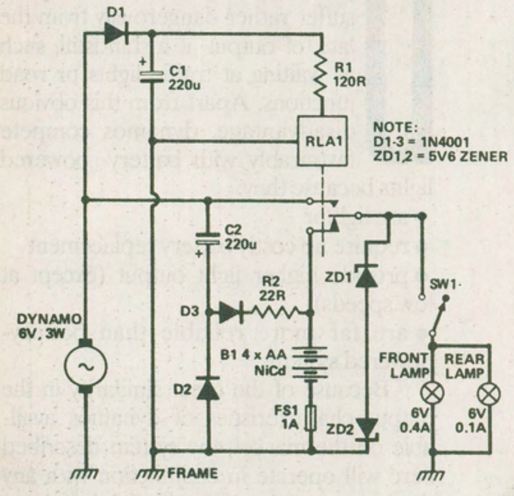


Fig. 1. The circuit diagram.

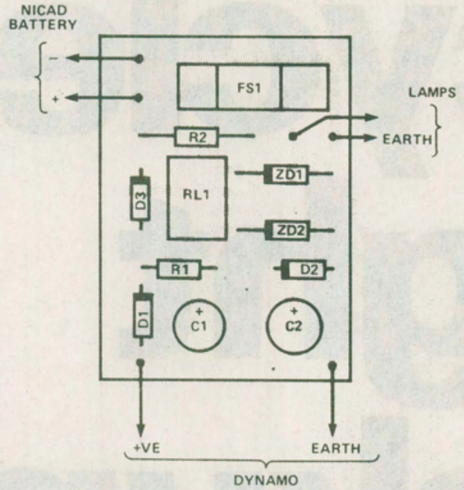


Fig. 2. The component overlay.

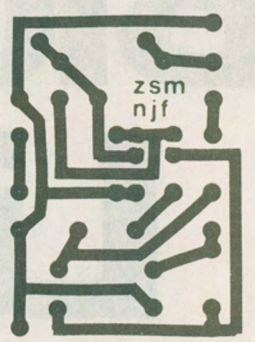


Fig. 3. The printed circuit foil side.

solidly connecting one terminal of the dynamo to the frame. Some commercial backup units require that the dynamo is isolated from the frame, easier said than done. The system described here does not impose such a restriction, thus making it easier to install by current and future dynamo users.

The output characteristics of all dynamos are closely matched to the lamp load. On most sets a 3W dynamo supplies a 6V, 0.4A, 2.4W front bulb and a 6V, 0.1A, 0.6W rear bulb. Unfortunately when the front bulb blows the rear bulb follows in seconds as the output voltage rises. When the rear bulb blows, the increase in brightness of the front bulb drastically shortens its life.

Choosing The Battery

Typical AA-size NiCads have a capacity of 500mAh and recommended charging currents of 50mA and 150mA for 15 and 4 hours respectively. When the bicycle is at standstill, the total current to both lamps supplied by a battery of four NiCad cells is around 0.45A, so a fully charged battery will last for about 45 minutes without dynamo intervention. Obviously the battery will not be used like this in normal circumstances.

Non-rechargeable cells can also be used if required. The charging circuit components D2, D3, R2 and C2 may then be omitted. If over-voltage protection is not required the zener diodes can be also eliminated. The PCB overlay is shown in Fig. 2.

Construction

The PCB measures only 45x32mm, so it was possible to fit all the items (PCB, battery and switch) in a compact box measuring 112x62x31mm. The unit can be neatly fitted on the bicycle tubular frame by metal clips, cable ties, etc.. Though less attractive (but cheaper) two capacitor clips were successfully used on the prototype.

The best position for the unit was found by the authors to be on the back of the seat down-tube just ahead of the rear mudguard. This gives the unit extra protection from rain, with the seat (and rider) acting as an umbrella.

No battery holder is used. Instead, the NiCad cells are connected in series by soldered connections. This is deliberate. It eliminates the problem of bad contact that bedevils all battery systems and it is more compact. Obviously if non- rechargeable AA cells are used, a holder will be necessary and the box made larger.

At the time of writing three units had already been used for two years with excellent results.

How It Works

Figure 1 shows the complete circuit diagram for the unit. D1, C1 and R1 provide DC supply to the relay coil. The bicycle speed at which the supply to the lamps changes over from the battery to the dynamo is determined by R1. For the dynamo used, 120R gave a smooth changeover with the least light flicker.

D2, D3, C2 and R2 constitute the charging unit. Voltage-limiting is achieved by the back-to-back zener diodes ZD1 and ZD2. There are two modes of operation.

a) Normal, SW1 on. When the dynamo is stationary the lamps are connected to the battery. When the dynamo voltage rises, the relay picks up and the lamps are connected to the dynamo. The peak charging current in this mode is about 50mA.

b) Fast charge, SW1 off. If the dynamo is engaged with SW1 off, the charging current increases to about 90mA. This is useful to accelerate the battery charging during daylight riding. ZD1 and ZD2 limit the voltage. Without them the charging current will reach excessive levels and damage the NiCad cells. ■

PARTS LIST

Resistors
(all 1/4 W 5% unless specified)
R1 .... 120R (see text)
R2 .... 22R 1/2W

Capacitors
C1, 2 .... 22u 25V electrolytic

Semiconductors
ZD1, 2 ..... IN5339B 5V6 5W
D1-3 ....IN4001 or similar

Miscellaneous
B1 .... 4 NiCads
FS1 .... 1A fuse
RLA1........... 6V, 120R coil, SPDT ultra-miniature relay
SW1 ...... SPST toggle switch

PCB,case, mounting clips, fuse, clips, nuts and bolts. Most of the components for this project are easily obtainable from normal sources. If the overvoltage-protection zener diodes are not available, they can be omitted. Any suitable 5 to 6V relay can be used, such as Radio Shack 275-240; it may be necessary to run wires to the PCB and mount the relay off-board.