12 VOLT CONVERSION

How to convert bikes with 6 volt direct lighting systems to 12 volts, Pete Roberts explains.

MANY lightweights and dirt bikes are fitted with 6-volt direct lighting, an arrangement which leaves a lot to be desired in light-power and which precludes the use of electrical accessories.

Here Pete Roberts explains how to convert 6V direct systems to 12V operation but it must be emphasised that the job is not as simple as converting machines equipped with alternators, which was featured in our 17 March, 82 issue.

It is necessary to modify the generator and the bike will almost certainly need re-wiring — alterations which could invalidate the warranty on a new machine. There are so many different variations that it is impossible to say that every direct lighting system can be converted but the ones which have been tried have given 50 per cent more output from the generator. No extra strain is placed on the windings as the current is the same as before and it is excessive current which causes damage through over-heating.

To understand how the conversion works, a basic explanation of the 6-volt direct system's charging arrangements is needed. Diagram 1 shows in "skeleton" form the arrangement found on most machines. The ignition windings are shown but, as in all but a few special cases, detailed later, the ignition system is entirely separate, it is left strictly alone throughout the entire job. The generator lighting coil usually has two outputs, one being a low voltage "tap" near the "earthy" end of the coil, which is connected to the frame. When the lights are in use the voltage available at the "hot" end of the coil is about 7 volts; this, of course, being the correct value for charging the battery. As the output from the coil is alternating current, a rectifier is needed to convert the AC charging current to direct current.

When the lights are in use, the rectifier is connected to the hot end of the coil by the appropriate contacts in the lighting switch. However, during daytime riding with no lights in use, the unloaded lighting coil's output may rise to many tens of volts. Such a high voltage would rapidly ruin both battery and rectifier, so under these conditions the input to the rectifier is switched to the lower voltage tap on the coil.

Sometimes an electronic regulator is connected across the lighting coil to maintain its output at the correct voltage whether lights are in use or not. With this arrangement the rectifier is usually permanently connected to the coil's full output. Any such regulator must be removed when converting to 12-volts; other arrangements will be made to regulate the battery's charging rate.

As the small batteries used in direct systems only need a small trickle charge to maintain them, a single diode rectifier is used in the relatively inefficient "half wave" configuration. A half wave rectifier only utilises half of each cycle of the incoming AC and this is insufficient for the greater demand of the 12-volt system. Instead, a 4 diode full wave bridge rectifier is used (Lucas type 49128A).

Full wave rectification uses both halves of the incoming AC, and as a result is far more efficient. The specified Lucas device will handle the output of any single phase generator that I can think of, so I would strongly recommend its use rather than certain "replacement" rectifiers sold by some outlets which may not have the correct characteristics for the job.

Full wave bridges require that both sides of the AC supply are floating with respect to ground. However one side of the lighting coil is connected to ground. This must be disconnected and brought out, via a separate lead, to the rectifier. Any taps on the lighting coil should be ignored, as the full output of the coil is used at all times. Diagrams 3 and 4 show both points and CDI generators before and after modification.

Diagram 5 shows the special case mentioned before; the arrangement found on some Yamaha trail bikes, although it may crop up elsewhere. As can be seen, the lighting coil also supplies part of the current for the ignition system. As well as the lighting coil being modified as mentioned previously, the earthy end of the ignition source coil must be disconnected from the lighting coil and connected directly to frame. This arrangement may cause a drop in HT voltage. If misfiring or difficult starting is encountered, then a gold-palladium spark plug should be fitted.

Some Honda machines, notably the early XL250, have the peculiar arrangement shown in Diagram 6. One coil earthed at one end, feeds the headlamp. Another "floating" coil charges the battery via a full wave bridge. "Ah-ha," I hear, "don't have to buy a new rectifier!" Wrong! The generator coils are rewired as shown in the diagram; but as the output of the two coils is not the same, they cannot be connected in parallel. There are three AC output leads, and although the system is single phase, a 3-

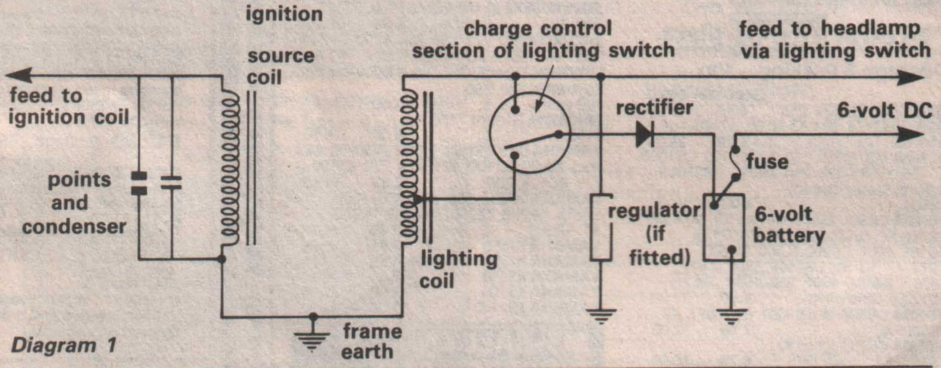


Diagram 1

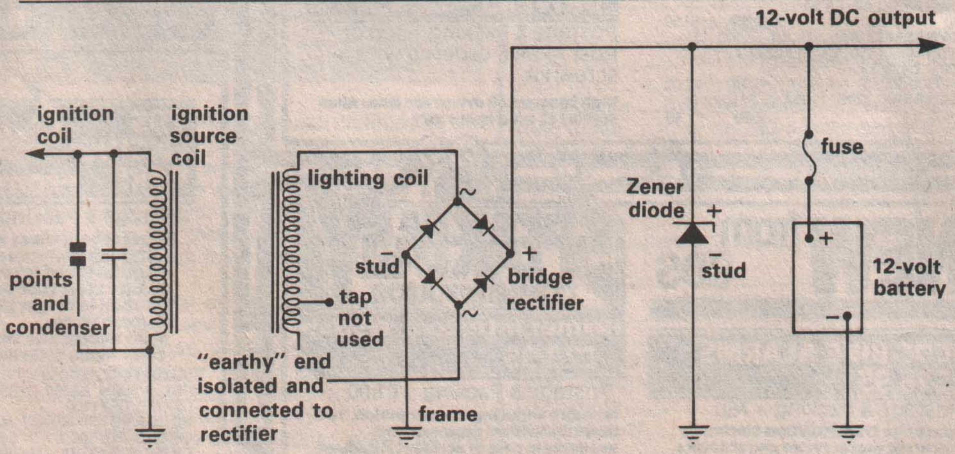


Diagram 2

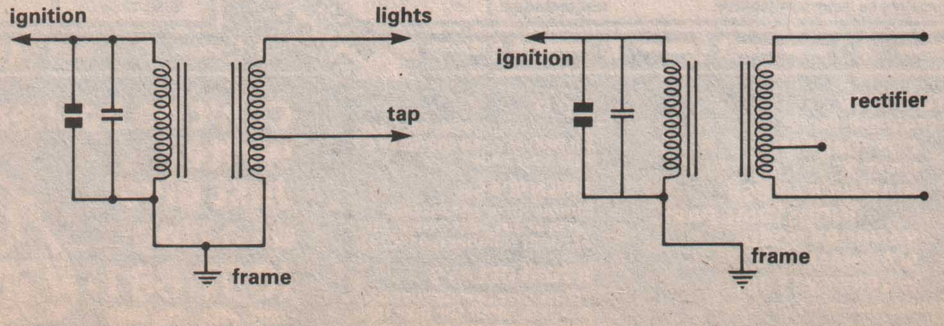


Diagram 3 a) before b) after

phase (or polyphase) rectifier has to be used. The specified type is Lucas Part No. 83539. This device has three AC input terminals, and the three leads from the generator may be connected to them in any order. *The rectifier stud is the −ve ground connection, and the single large (⅜") terminal is the positive output.*

We've now got a generator and rectifier set-up that should easily power a 12-volt electrical system. However it'll be giving full output all the time, so unless you ride around with your lights on, chances are the battery will be boiled alive!

The full 12-volt charging system is shown in Diagram 2. You will notice the mysterious object known as a Zener diode wired across the output of the rectifier. This device, which looks like a large brass nut with a ⅜" spade connector at its top, is a sort of electronic safety valve. It is normally non-conductive but when the voltage across the battery reaches about 14.7 volts the device begins to conduct, shunting excess power to ground. (A system known as "shunt regulation").

Assuming that the battery is fully charged, and no lights are in use, the diode may be passing virtually all the generator's output to ground. The Law of Conservation of Energy says that all this energy can't just disappear; it is converted into heat and as a result the diode can get quite hot.

If it gets too hot it will self-destruct, so the heat generated has to be dumped somewhere. The method adopted is to mount the diode on a substantial "heatsink", which is a large piece of metal, which for this application should have an effective surface area of at least 36 square inches. This can either be the finned alloy type found fitted under the headlamp on some British bikes, or you can make one from a piece of heavy alloy plate, making sure that the area is at least 36 square inches. One word of caution! The rectifier is earthed via its mounting stud, so make sure that the stud has a good, clean connection to the frame.

The diode must be mounted as shown in Diagram 7. The area on the heatsink where the diode is going to sit must be cleaned to bare metal, and it is a good idea to apply a smear of silicone grease to aid heat transfer. The diode's earthing tag must be mounted on the rear of the heatsink and NOT between the diode and heatsink. If you do, the diode will overheat and burn out. Don't exceed 2lb ft tightening torque on the nut; the diode's stud is made of copper and will very easily shear off. The diode to use is the −ve stud Lucas item, Pt. No. 49589. Diode 49345, found on British bikes, together with rectifier 49072, are +ve earth types and MUST NOT be used. *Don't under any circumstances solder directly to either the rectifier's or Zener diode's terminals. The excessive heat may damage them. Always use the correct push-on terminals.*

Now for the battery. You can use any 12-volt item that can be made to fit, or alternatively two six volt items may be wired in series. If you do use two 6-volt batteries, then make sure that they are identical, or else all sorts of problems may arise. Don't use an ancient old knackered one together with a brand new one, either.

A fuse is VITAL and MUST NOT be omitted. You can buy either British pattern fuse-holders, (taking 1¼in fuses) or Japanese fuseholders, which take a 1in fuse. With British fuses, use either a 25 or 35 amp fuse. Japanese fuses only seem to be obtainable up to 20 amp, so use one of these. A 15 amp will do at a pinch. DON'T nick the 13 amp fuse out of a mains plug! Mains fuses are rated differently to automotive fuses, and anyway, 13 amps is not big enough.

One great advantage with this conversion, should you ride mostly on the rough, is that the battery can be dispensed with. The charging system remains the same except that the battery is replaced with a heavy duty electrolytic capacitor. This is a small cylindrical device, about 2in by 1¼in diameter, that serves to smooth out the pulsating DC output from the rectifier by acting as a short term electrical "store".

As it cannot hold any appreciable amount of electricity, lights etc are only available when the engine is running. The capacitor requires no charging current at all, so the full generator output has to be dissipated by the diode when no lights are in use, and particular attention has to be paid to cooling the diode. Use the largest heatsink possible, mount it where it will be in a good blast of air, and keep the heatsink free of mud etc.

The capacitor is polarity conscious and must be connected the right way round or else it may be ruined. The recommended Lucas 2MC capacitor has a small ⅛in terminal marked with a red dot; this is the positive terminal. A double ¼in terminal with no coloured marking is the negative terminal.

Lucas don't recommend that the capacitor be dropped or subjected to excessive vibration, and needs careful handling. The ripple current through the device is quite high, so use the specified Lucas item which has been designed to cope with it, rather than a capacitor made for general electronic uses. In this application such a capacitor may overheat and explode! This is the reason I haven't stated the value or working voltage.

A fuse is not needed in this circuit unless a battery is fitted. Should you fit a battery at any time, the capacitor may be left in circuit. With the capacitor system, I don't recommend the fitting of indicators; this circuit is designed for basic lights only.

Having sorted the charging system, you'll now have to turn your attention to the rest of the bike. You must fit 12-volt bulbs throughout, and, in the case of the headlamp, this may mean changing the headlamp unit complete. Some of the small 6-volt bulbs used in direct systems have funny bases which have no 12-volt counterpart. In such cases, a replacement lamp from, say Cibié, will have to be fitted. As a rule of thumb, use a 12-volt bulb with a rating of up to half as much again as the original 6-volt device. The rear lamp should be fitted with a 12V 6/21W bulb, and ▶

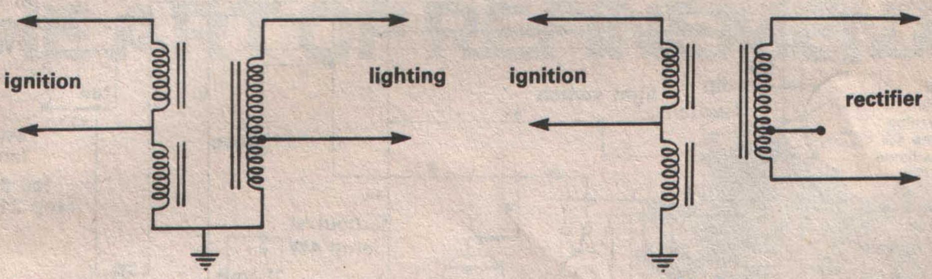


Diagram 4 a) before b) after

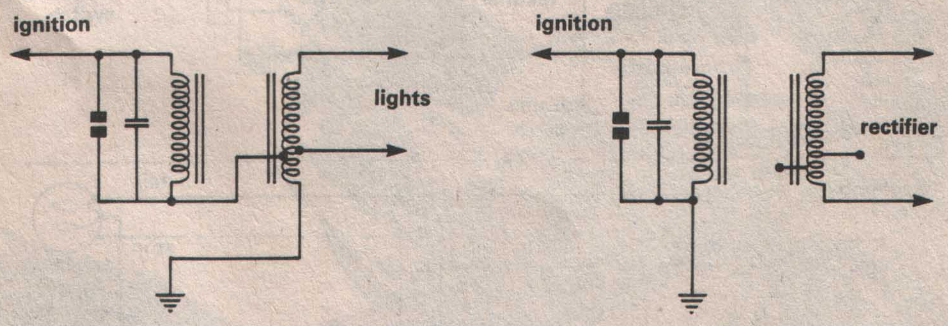


Diagram 5 a) before b) after

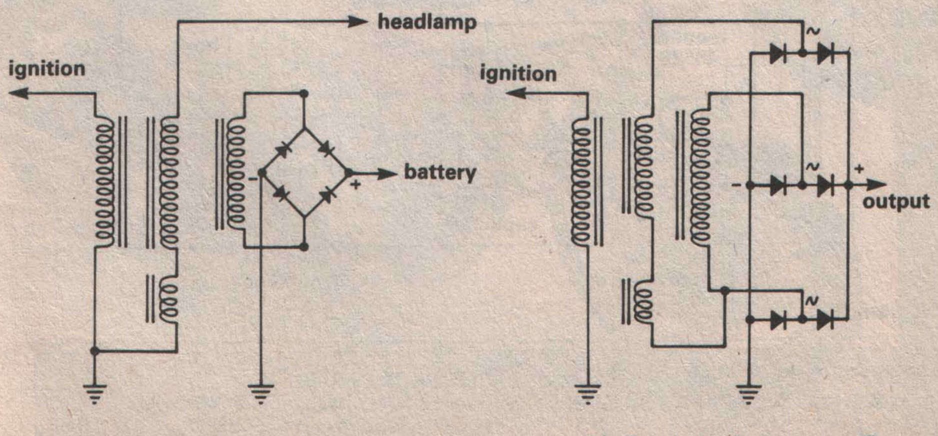


Diagram 6 a) before b) after, with 3-phase rectifier

the indicators, 12V 21W.

Use a Lucas 2FL flasher unit. These are available cheaply from most car spares outlets. Don't forget to change the idiot lights, instrument and parking bulbs, 12V 4W will do here. Change the horn for a 12-volt item but no change of ignition coil is necessary.

Rather than try to adapt the original wiring, particularly if this is in poor condition, it would be best to remove all the old wiring except for that associated with the ignition system and indicators. Whilst this wiring is exposed to view, you should check it for damage or frayed insulation and repair as necessary. This is particularly important on machines fitted with electronic ignition. You should then rewire the bike according to Diagram 8 or 9 depending whether you want the battery or capacitor system. I have always used the following colour code when wiring; it helps to identify various circuits and aids fault finding:—

RED. Main positive feed from battery.
BROWN. Switched +ve from ignition switch.
YELLOW. AC circuits.
BLUE. Lighting circuits.
GREEN. Stoplight circuits.
VIOLET. Miscellaneous (e.g. horn).
BLACK. Main earth return.

This last lead is incorporated as, for several reasons, it is not a good idea to rely on the frame for a return. The earth lead MUST however be connected to the frame at one point at least. All wiring must be done in a neat and orderly manner using 14 strand, PVC insulated, auto electrical cable. DON'T use single strand bell wire, house wiring cable, electronic hook-up cable, old knicker elastic or anything else except the specified cable unless you want trouble.

When finished, the entire wiring harness must be double lapped with good quality harness tape and routed so that it will not be trapped or frayed in use. This latter point is particularly important at the steering head area. Use the original wiring for the indicators.

The original ignition switch must be retained, but it should be used for ignition switching only. In the case of combined ignition/lighting switches the lighting sections can be ignored and a separate on/off switch be used. In the case of combined light and dip switches, these can still be used with the 12-volt system.

The only sections of the ignition switch used are the igniton and battery sections. The ignition side must be wired EXACTLY as before, making sure that the switch is properly earthed. The battery side is wired as shown in the relevant diagram. The capacitor system does not need a switch in the D.C. side of the system as there is no power available when the engine is stopped. In this system, only the ignition is switched.

All technical enquiries regarding this article should be sent to *Mechanics'* Troubleshooter pages. Try and enclose a copy of your original wiring diagram if you can. The parts mentioned on the right are available as a kit from P. E. Roberts, P.O. Box 34, Runcorn, Cheshire WA7 2PT. Alternatively, if you live in that area, Colin Rides Motorcycles, 145 Albert Road, Widness, Cheshire (051-424 7486) can do the entire job for you.

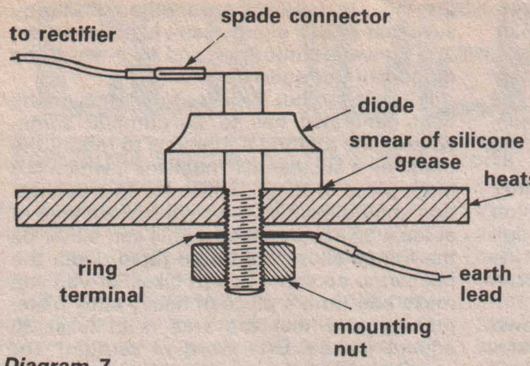
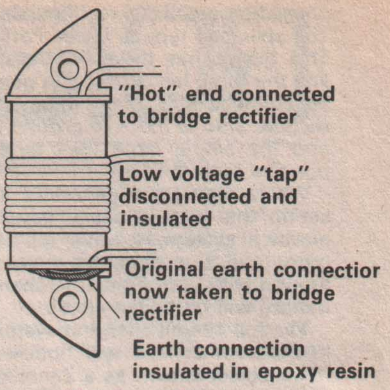


Diagram 7



Lighting coil after modification

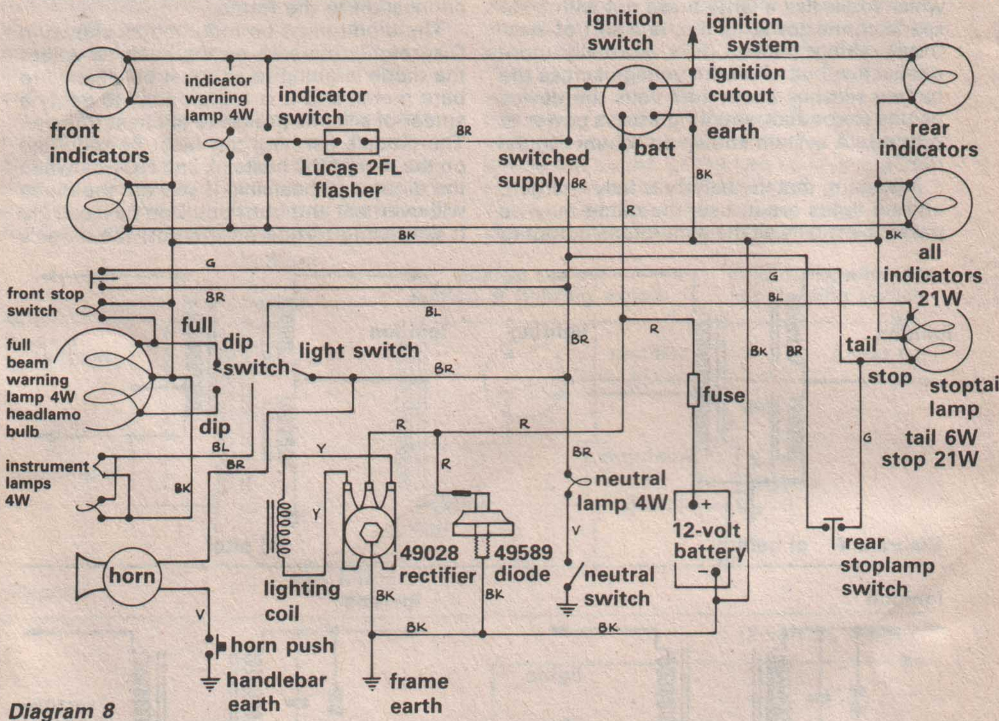


Diagram 8

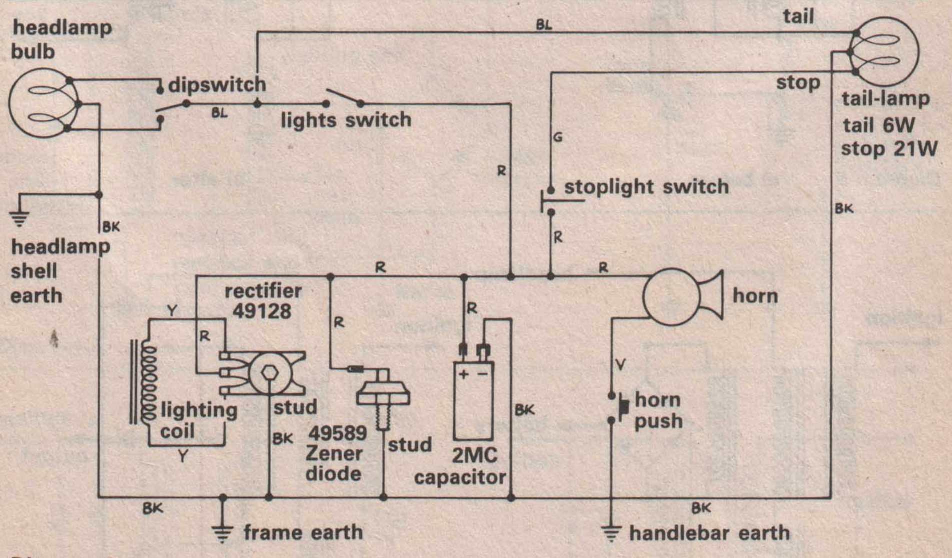


Diagram 9

The ignition switch colour codes applicable to the Big 4 makes is as follows:

MAKE	EARTH	IGNITION	BATTERY +	SWITCHED SUPPLY
Honda	Green	Black/White	Red	Black
Suzuki	Black/White	Black/Yellow	Red	Orange
Yamaha	Black	Black/White	Red	Brown
Kawasaki	Black/Yellow	Black/White	White	Brown

PRICES OF PARTS:

Lucas single phase rectifier 49128A	£7.63
Lucas polyphase rectifier 83539	£8.92
Lucas neg stud Zener diode 49589	£7.20
Lucas 2MC capacitor 541 700 09	£3.40
Heatsink	£3.50