The following information should prove useful to owners of older model MGs (MGA and earlier) and other British cars using a Lucas 12 volt Positive ground electrical system. It is taken from service bulletins published in the 1950s by Joseph Lucas, Prince of Darkness.

VEHICLE WIRING INFORMATION

CABLE (WIRE) IDENTIFICATION).

With few exceptions, the electrical system of a motor vehicle can be considered as a series of simple circuits, each consisting of the component, its switch and three wires—feed, switch wire and return. On ground return systems, the return circuit is provided by the frame of the vehicle, although in the case of components insulated from the chassis, a ground lead is also necessary. Some variations are to be found, such as fuses, two-way switching and so on., but the principle of feed wire, switch wire and return remains, and it is upon this principle that the Lucas color scheme is based. Feed wires carry braiding of a main color only; switch wires have the main color of feed with a colored tracer woven spirally into the braiding, while return or ground wires are black in color. Where components are switched or controlled in the ground side, that is, with the switch wire on the return side of the unit instead of on the feed side, this is normally indicated by the use of a black tracer.

Main colors, of which there are seven, are allocated to the circuits shown below. The practice of feeding certain of the accessories through the ignition switch and auxillary lighting circuits through the side and tail lamp switch is recommended, so that the side/tail lamp switch and ignition switch wires become feeds to other circuits or, in effect, master switch wires.

CABLE SIZES.

To provide flexibility, cable cores consist of not a single wire but of a number of identical strands. The number and diameter of the strands are detailed in the cable size, e.g., 44.012 indicates a cable consisting of 1.012" diameter (30 S.W.G.) wire. A general guide to the cables required when wiring a typical 12 volt system is as follows:

Circuit	*Wire Size*	*Current Carrying Capacities*	
Battery Main Feed	44.012	22 amperes	44.012
Generator Main Feed	28.012	14 "	28.012
Other Circuits	14.012	7 "	14.012

It must be emphasized that the above applications are only nominal. To determine the cable size most suited to a particular circuit, due consideration must be given to the voltage-lowering effect of length and loading. The total voltage drop in a circuit should never exceed 10% of the battery voltage. A fully loaded circuit involving long lengths of cable may often need a cable of larger size in order to limit the voltage drop to an acceptable level. The electrical circuits of new vehicles equipped with Lucas wiring are most carefully studies at the prototype stage to ensure the correct use of cable sizes.

CABLE COLORS.

- BROWN. Battery circuit. From battery or starter switch to ammeter or voltage regulator and feeding lighting and ignition switches from regulator or fuse block terminal A1. Also from starter switch to electric clock, inspection lamp sockets and battery auxiliaries fuse (from which are also fed electric horns, cigar lighter, interior lights, etc.)
- YELLOW: Generator circuit. From generator D terminal to regulator D terminal and to ignition warning lamp.
- WHITE. Ignition circuit and all requirements essential when ignition is switched on but which do not require fusing, e.g., electric fuel pump, starter solenoid switch, etc.
- GREEN. Auxiliary circuits fed through ignition switch and protected by the ignition auxiliaries fuse, e.g., stop lights, fuel gauge, direction indicators, windscreen wipers, etc.
- BLUE. Headlamp circuits. Fed from terminal S2 (or H) on lighting switch.
- RED. Side and tail lamp circuits. Fed from terminal S1 (orT) on lighting switch. Included in these circuits are fog, panel lamps and other lamps required only when side lamps are on.
- BLACK. Ground circuits. If a component is not internally grounded, a cable must be taken to a good grounding point on the chassis.

STARTING SYSTEM QUICK CHECKS

CHECK 1. BATTERY.

(A) Hydrometer readings:

1.270 - 1.290 specific gravity		Fully charged cell
1.190 - 1.210 "	"	Half charged cell
1.100 - 1.120 "	"	Discharged cell

(B) Heavy discharged test: Cell readings remain constant at approximately 1.5 tO 1.6 volts for about 15 seconds. If hydrometer readings are low, charge battery.

CHECK 2. BATTERY VOLTAGE ON LOAD: Connect voltmeter across battery terminals. Close starter switch. Voltage should not fall below 8.5 to 9.0 volts. If voltage is lower than this, check battery and switch connections for tightness.

CHECK 3. VOLTAGE AT STARTER: Connect voltmeter between main starter terminal and ground and operate starter. Voltage should not be lower than 8.0 t0 8.5 volts. If reading is lower check cable from switch to starter and make sure insulation is good and terminals are clean and tight.

CHECK 4. VOLTAGE DROP ON MAIN LINE: Connect voltmeter between starter terminal and negative battery terminal. Operate starter. Reading should not exceed 0.5 volts. If reading esceeds 0.5 volts and all connections are tight, then replace battery cables due to voltage loss.

CHECK 5. VOLTAGE DROP AT STARTER SWITCH: Connect voltmeter across starter switch terminals. Operate starter. Reading should not exceed 0.5 volts. If reading exceeds 0.5 volts, then replace starter switch as it has a voltage leak across its contacts.

CHECK 6. VOLTAGE DROP ON GROUND LINE: Connect voltmeter between positive (ground) battery terminal and ground. Operate starter. Reading should not exceed 0.5 volts. If reading exceeds 0.5 volts, check all ground connections, in particular the engine bonding (ground) strap as engine is mounted on rubber engine mounts and, therefore must have a good ground through strap.

CHARGING SYSTEM

The charging system generally holds a large amount of mystery to most owners and do-it-yourself mechanics. Many generators and/or voltage regulators have been condemned and replaced erronously due to improper diagnoses. Also, after replacing either component, if the entire charging system is not checked and adjusted properly, both the new and old units are subject to prompt failure. By carefully following the steps listed below, you will be able to diagnose and rectify any problems in the charging system.

Always commence the tests at the source of supply—The Generator (TEST 1). It is necessary to use a good quality moving coil voltmeter with a full scale deflection of at least 20 volts (50 volts is preferable), with divisions suitable for taking readings to within 0.5 volt. These tests are valid only on cars equipped with Lucas Compensated Voltage Control Regulators, Types MCR1, MCR2, RF95, RF95/3, RF96, RF97, RB106/1, RB106/2, RB107, RB108 (2 bobbin types). All tests are made with the generator and regulator installed on the vehicle.

Inspect the fan belt for wear and correct tension, and adjust as necessary. If worn or frayed, fit a new belt before proceeding with the tests.

TEST 1.

VOLTMETER CONNECTION: Disconnect leads from generator. Connect one lead of voltmeter to D terminal on generator and the other to a good ground. Start engine and raise speed to approx. 3000 rpm.

READING: A) 2-4 volts at approx. 3000rpm.
B) Zero reading.
C) Rising volts with rising speed.

ACTION: A) Armature connections are o.k. Proceed to Test 2.
B) Examine brushes and make sure they are free in their boxes and making good contact with commutator. If still no reading, fault is with armature which must be replaced.
C) Internal short between D and F terminals. Examine field coils and rectify as necessary or fit replacement coils.

TEST 2.

VOLTMETER CONNECTION:

Connect meter as in Test 1. Link terminals D & F on generator. Speed up engine gradually to about 3000 rpm.

READING: A) Rising volts with rising speed—full scale reading at fast idle.
B) 2-4 volts as engine is revved up.
C) Zero volts.

ACTION: A) Generator is in order. Proceed to Test 3.
B) Open circuit in field coils. Rectify or fit replacement coils.
C) Grounded field coils or field connection. Rectify as necessary.

TEST 3.

VOLTMETER CONNECTION:

Reconnect leads of generator. Remove leads from D and F terminals at Regulator. Connect one voltmeter lead to end of D lead and the other to a good ground.

READING: A) 2-4 volts.
B) Zero reading.
C) Rising volts with rising speed.

ACTION: A) D lead from generator to control box is in order. Proceed to Test 4.
B) Rewire D lead, which is open-circuited.
C) Locate short between D and F.

TEST 4.

VOLTMETER CONNECTION:

Leave voltmeter connected as in Test 3. Join D and F wires together. Raise engine speed very gradually to approx. 3000 rpm

READING: A) Rising volts with rising speed.
B) Zero reading.
C) 2-4 volts.

ACTION: A) Wires from generator to regulator are in order. Proceed to test 5.
B) Grounded F lead.
C) Open circuit in field lead between generator and regulator

VOLTAGE REGULATOR TESTS

(IMPORTANT. Before conducting the following tests, it is necessary to isolate the battery from the generator. This is best done by inserting a piece of dry, clean, thin cardboard between the cut-out points in the voltage regulator.)

TEST 5.

VOLTMETER CONNECTION:

Reconnect generator leads to regulator terminals D & F. Be sure these are connected properly, i.e., Yellow (larger) lead to D terminal, etc. Connect one lead of voltmeter to Terminal A and the other to terminal E. Engine stationary.

READING: A) Battery voltage.
B) Less than battery voltage.

ACTION: A) Regulator ground connection in good order. Proceed to Test 6.
B) Rectify bad ground or broken ground wire between Terminal E and chassis.

TEST 6.

VOLTMETER CONNECTION:

Proceed to check regulator setting. Remove regulator cover. Isolate battery as described above. Connect one lead from voltmeter to Terminal D (or frame of regulator) and the other to a good ground.

READING: A) With engine running at approx. 3000 rpm, voltage should remain constant within the following limits:

With ambient temperature between 50° & 68° — 16.0 to 16.5 volts
" " " " 86° & 104° — 15.5 to 16.0 "

B) Voltage remains constant but outside given limits.
C) Rising volts with rising speed to about 3000 rpm and beyond.
D) Reading approximately half setting.
E) Voltage does not rise with engine speed or is erratic.

ACTION: A) Regulator in order. Proceed to Test 7.
B) Adjust regulator by turning the adjusting screw clockwise to increase or counter-clockwise to decreaee the setting. Check setting by raising speed from zero.
C) Suspect broken shunt winding in regulator bobbin. The ground lead from regulator terminal E is common to both shunt windings (regulator and cut-out). Hold a screwdriver near top of bobbins and test for magnetic pull. If there is pull over one bobbin core and not the other, suspect open circuit in the latter. If no pull on either, check for open ground lead. Replace defective unit.
D) Suspect regulator contacts not passing current causing 63 ohm resistance to be in circuit the whole time. To test, bridge the contacts with a screwdriver. This closes the circuit between D & F and we should get rising volts with rising speed, thus proving the contacts are burnt or corroded.
E) Check air gap settings: Types MCR1, MCR2, RF95, RF96, RF97, RB106/1; insert a 0.020" feeler gauge between the crank of the armature and the L-shaped frame, and

a 0.012-0.020" gauge between the top of the core and the underside of the brass shim on the armature. Loosen the screws holding the regulator armature to the top of the L-shaped frame. Press downwards and backwards. Tighten the screws and check that clearances are as shown in Diagram 1. Types RF95/3. RB106/2, RB107, RB108; slacken the fixed contact screw and unlock armature securing screws. Insert appropriate feeler gauge between armature and core face. Press armature down squarely against the gauge and re-tighten the securing screws. With gauge in position, screw the fixed contact down until it just touches the moving contact and tighten the lock nut. (Refer to Diagram 1). Reset voltage adjusting screw as described under 6B.

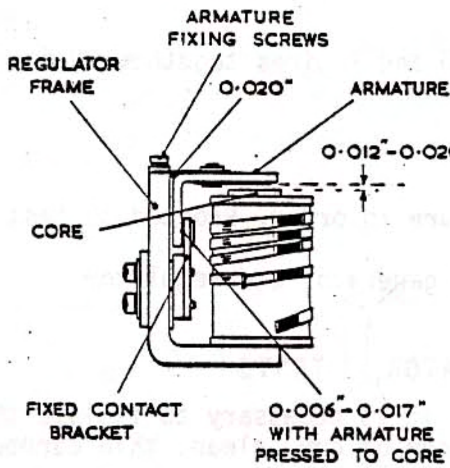

Diagram 1.

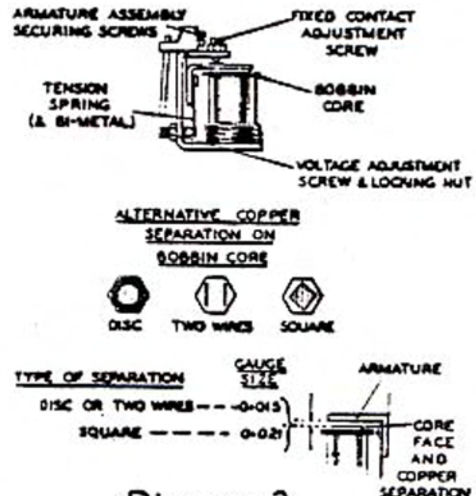

Diagram 2.

TEST 7.

VOLTMETER CONNECTION:

Remove card from between cut-out points. Connect voltmeter to Terminal A on regulator and to a good ground. Engine stationary.

READING. Battery voltage

ACTION: Proving that circuit from battery through ammeter to Terminal A is ok. Proceed to Test 8.

TEST 8.

VOLTMETER CONNECTION:

Leave voltmeter connected as in Test 7. Start engine.

READING: A) As cut-out closes, the reading should increase 0.5 to 1.0 volt above battery voltage, and increase to the regulator setting in Test 6.

B) No voltage or very low voltage when cut-out points close.

ACTION: A) Cut-out is in order. Proceed to Test 9.

B) Clean and adjust cut-out points so they meet correctly.

TEST 9.

VOLTMETER CONNECTION:

Connect one lead of voltmeter to D Terminal of regulator and the other to a good ground.

READING: A) Cut-out points close when voltage is between 12.7 and 13.3 volts.

B) Cut-out points close outside the above limits.

C) Cut-out does not close.

ACTION: A) Cut-out is in order.

B) Adjust by turning the adjusting screw clockwise to increase and counterclockwise to decrease the setting. Re-test with voltage rising from zero.

C) Fit replacement unit.

Two fuses are incorporated in the RF95 regulators. The main feed is via the ammeter to the A Terminal of the regulator, then through the series winding to the A1 Terminal. Terminal A1 is also the feed to the ignition switch and from there to A3 via internal connections in the regulator through the fuse to the A4 Terminal. Any accessories connected to A2 will work irrespective of the ignition switch position. Accessoried connected to A4 will operate only when the ignition is switched on. The system is similar in other regulators, but the fuses are mounted on a separate base

Prepared and submitted by Al Moss (3/81)