



## Electrical safety

The note about electrical safety (Education in Science, June 1995) elicited two letters about ELCBs, earth leakage circuit breakers. The letters, and the comments from the Safeguards in Science Committee, will be of interest to readers.

In the June edition of Education in Science (page 15) it is stated that earth leakage trips will not protect when the Earth pin is not connected. Fortunately, this is not the case. I laboured under the same misapprehension myself for some years, but was put right by a representative of 'ARGOS' when I suggested it was wrong for them to encourage the use of such trips with lawn mowers, etc. which have only two core cables.

In fact (as I learnt) the trip works by sensing a difference in the Live and Neutral currents (two coils wound on top of each other will do the trick nicely) and hence will detect any leakage to earth, even if it does not go via the Earth wire.

On the subject of wiring 3-pin plugs I do not personally think that pupils should ever connect an open-ended piece of wire into a plug. It is safer in the real world to connect to the equipment first and then to the plug —showing them how to do it properly. Surely it would be possible to design a simple piece of 'equipment' which would light up if wired correctly but do nothing otherwise — a business opportunity? '

A. R. Hawton, Northwich, Cheshire

Recent discussions in our school have involved the suitability of earth leakage circuit breakers and residual current devices. Please could you let me have any comments about their suitability when used with devices that do not have earth wires fitted, e.g. some lawn mowers.

Philip Boyle, Stockton, Cleveland

Reply from the Safeguards in Science Committee

A.R. Hawton is quite correct in saying that ELCBs will detect any leakage to Earth, even if this is not via the earth connection. The point he misses is that if the flow of current to Earth to operate the ELCB does not go via the cable, it must go by some other route, and this can quite possibly be the user. The type of ELCB usually found in schools is called a residual current device (RCD) and has an operating time, typically, of 30 ms. The RCD is unable to limit the current during this time, so if the earth pathway is through the user a fatal shock could well be administered.

In a laboratory with modern floor covering, bench surfaces, plastic coated taps and plastic pipework, reliable earth connections are essential otherwise line (live) to neutral connection through the body with very little earth leakage is possible.

Mr Hawton's second point, about wiring 3-pin plugs, we would agree with: it is safer to connect the piece of equipment and then the plug. However, we are in a situation where pupils are learning and they may connect the plug not only incorrectly but dangerously so, when learning how to handle the 230 V ac supply safely, we must not allow pupils access to it in a potentially hazardous situation. The 'piece of equipment which would light up if wired correctly' is not a problem, but what the pupil has done with the wires, fuse, pins, screws and stripped insulation at the 'other' end is! For this reason a plug that will not go into the socket, no matter how well or badly wired up, is to be preferred.

Philip Boyle asks about ELCBs being used with devices which have no earth wire in the cable. Most of these are 'double insulated' which means either that the casing is a non-conductor or there are two layers of insulation between a metallic casing and any live parts.

The use of ELCBs with such device depends on an efficient pathway to earth. A flow of current from line (live) to the earth causes the ELCB to switch off the current. When the operator of an electric lawnmower slices through its cable the chances of direct leakage to earth is very good, with consequent protection for the operator. However, a badly worn cable being inspected by the operator who touches a strand of live wire poking through the insulation may give a severe electric shock. In this case, the current that flows through the operator to earth in the 'tripping time', typically 30 ms, is not regulated and could be several ampères if, for example, the operator is standing on damp grass.

The scenario of a sliced-through cable not tripping the supply is possible but unlikely. In the laboratory this would be analogous to a pupil learning to wire a 3-pin plug, putting it into a socket with bare live and neutral exposed at the other end of a short length of table. Taking hold of live and neutral wires in opposite hands would then almost certainly lead to severe electric shock, possibly fatal, because little current would flow to earth. This is even more likely with modern shoes, floors, benches, etc. made with highly insulating composite material.

Note: The term ELCB (earth leakage circuit breaker) is not commonly used now. The term RCD (residual current device) is more common.