Dangerous VdG Speed Controller

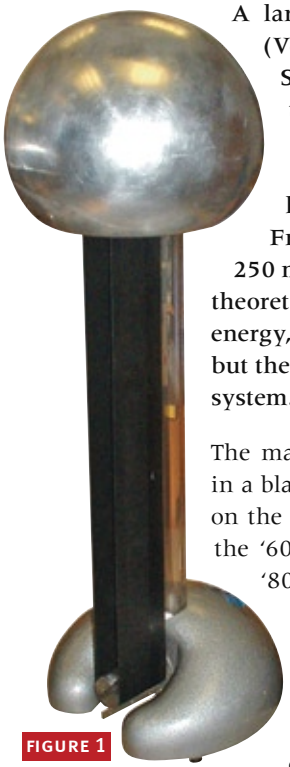

FIGURE 1

A large Griffin Van de Graaff generator (VdG), sometimes known as the Griffin Senior, (Fig. 1) was brought to us for testing, the school being concerned that it could be capable of producing a dangerous spark from the dome having read SSERC Bulletin 223[1]. From the size of the dome, about 250 mm diameter, the machine is indeed theoretically capable of storing 1.0 J of energy, which could be rather dangerous, but the greater danger is the mains electrical system.

The machine at fault had a speed controller in a black Bakelite box with ventilation grills on the top and bottom, the version dating to the '60s and '70s. (It was redesigned in the '80s with a 2-tone grey, metal case and improved mains connectors.)

The 3-wire mains cord from the 13 A plug goes via the speed-control box to the VdG motor. Within the speed-control box there is a large wire-wound variable resistor which is in series with the motor on the phase-live supply line. Above and below the variable resistor are large circular apertures in the Bakelite panels, top and bottom, covered by wire mesh. The following hazards were found:

- The size of mesh is too large. (> than 1 mm) (Fig. 2).
- If the mesh is depressed, it can touch the wire windings on the resistor, which are live at 230 V a.c. (Fig. 2).
- The meshes are unearthed (Fig. 2).
- The power connector between the control box and VdG is a 3-pin Bulgin plug (Fig. 3). This has unshrouded pins at mains voltage which can be opened easily by hand and does not adequately provide strain relief on the cord.
- The VdG base is not connected to the protective earth conductor. Whether this is by design or as a result of a fault condition, we did not have time to find out.

FIGURE 2

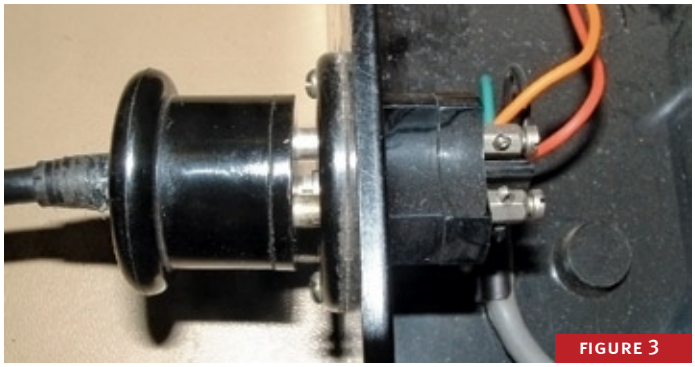

FIGURE 3

Apparatus with multiple faults such as these above should be taken out of service and either disposed of and replaced, or re-conditioned. Replacement is much the better option. Think of the image you present to the kids every time you produce apparatus like this VdG, designed in the '60s. The main problem with reconditioning the apparatus is that the job must be done competently. There is a significant chance that repairs, however well intentioned, might result in other dangers.

Another concern is why apparatus like the Griffin Senior is still in service when it carries the labels of two different electrical contractors who have tested it for safety. Why does it keep passing annual safety tests when it should have been failed?

A report on the faults of the Griffin Senior was published in the Bulletin in 1998[2]. Moreover it is probable that SSERC issued a warning to Regions in the '80s following an incident wherein someone got an electric shock. In addition the dangers of this speed controller, and Bulgin connectors and unearthed metal panels, were pointed out in our electrical safety training courses. We know that several hundred teachers and technicians will have handled this actual speed controller, and also these Bulgin connectors on other apparatus, on SSERC courses and been asked what's wrong with them. Yet we understand that this apparatus is still held by several schools. It just shows how difficult it is to get safety information to the persons who need to know. Perhaps it also shows that when persons find out about a problem they do nothing about it. Alarmingly we see how ineffectual are some of the routine electrical tests. Furthermore it may point to the lack of proper safety management by some employers. Last but not least in this litany of blame is the chronic underfunding for apparatus in science in some parts of Scotland. In some circumstances this can cause staff to ignore problems they feel they can do nothing about.

References

1. Van de Graaff generator hazards Bulletin 223 2007
2. Van de Graaff problems Bulletin 195 1998.

Figure 1
Griffin Senior Van de Graaff generator with speed controller. Product codes: L81-280, then XJE-400. Overall height = 760 mm. Dome diameter = 250 mm.

Figure 2
Wire-wound resistor in speed controller with circular aperture in bottom panel covered by wire mesh.

Figure 3
Mains supply to VDG motor is taken through this Bulgin connector from the speed controller.