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Short Communication

A battery powered nerve stimulator for the treatment of scoliosis

F. J. Scott and A. F. Trappitt

Department of Medical Physics, City Hospital, Hucknall Road, Nottingham NG5 1PB, England

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1. Introduction

Electrical nerve stimulators similar to that described here have been used for the treatment of scoliotic kyphotic curves in adolescent patients (Axelgaard and Brown 1980). This treatment is reported to be successful in arresting and, in some cases, reversing the course of the scoliosis. The patients treated have flexible curves of between 20 and 40 deg, and are at least a year prior to skeletal maturity.

Stimulators have a number of advantages over the traditional type of orthosis:

(i) The stimulator maintains or increases the strength of the supporting muscles rather than allowing them to fall into the disuse that results from the support of an orthosis.

(ii) The stimulator can accommodate all sizes of patients and does not need renewing to cope with growth.

(iii) Although use of the stimulator is normally recommended while the patient is in bed, some users may benefit from its use during the daytime and for this purpose it is almost totally concealed.

The design described here was evolved to meet the needs of having a smaller, more compact device with the necessary output capability and sufficient battery life. Simplicity of use and reliability are other important factors which have been taken into account.

2. Development

The idea behind the design and development of this device was to produce a smaller and electronically simpler stimulator than those currently available commercially, preferably at a lower cost per unit. However, such simplification should still retain the major characteristics of the output. These are as follows:

(i) Current pulses of approximately 0.2 ms duration with a pulse period of 2–4 ms (25–50 Hz).

(ii) A gated output with on–off ratios of between 1 to 2 and 1 to 4 to reduce muscle fatigue.

(iii) Approximately constant current output stage to reduce the changes in stimulation level resulting from electrode impedance changes.

(iv) Pulsed stimulation currents of at least 50 mA peak into a load of 1–2 kΩ.

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after the setting in order to turn the device on and off. Since the setting has previously been found to be comfortable by the patient, and the stimulus is turned on slowly by the amplitude modulator, the patient will not receive an unpleasant shock. If the design is implemented using a patient-accessible level control then it is essential to combine the on–off switch with this control to prevent the hazard of turning the stimulator on at full output. The present arrangement also has the advantage of giving direct access to the battery contacts so that it may be recharged without removal and in addition prevents the charger and electrodes being connected to the stimulator at the same time. This precludes any possibility of the patient receiving a mains shock via the electrodes if a fault occurred whilst recharging the battery.

4. Conclusion

The whole circuit is built on a glass fibre printed circuit board in an ABS box measuring 11 cm × 7 cm × 3.5 cm and weighing 180 g including battery. The stimulus amplitude control is recessed to prevent accidental adjustment and the only other external control is the output socket which forms the on–off switch with the electrode plug and provides for connection of the battery charger. Figures 2 and 3 show the prototype stimulator.

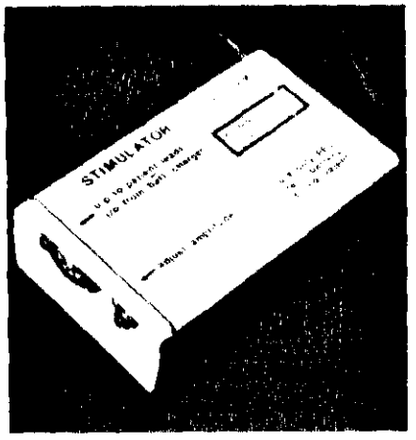

Figure 2. Prototype stimulator.

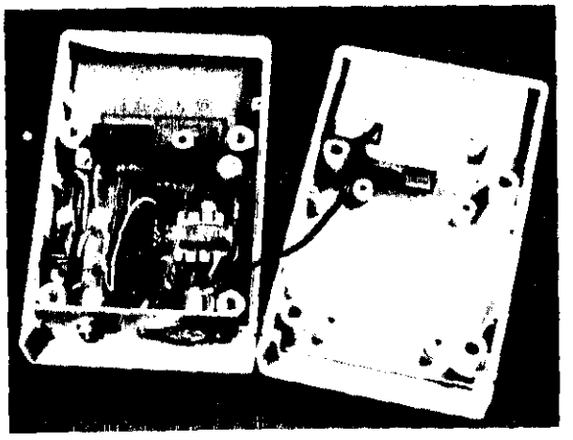

Figure 3. Inside view of the stimulator.

5. Current use

Ten of these devices are currently being evaluated alongside similar commercial devices. Carbon impregnated silicon rubber electrodes of around 5 cm area each are being used. To avoid the need for electrode jelly and separate adhesive tapes, self adhesive discs of gum are used to attach the electrodes (Raymar Ltd, Henley-on-Thames, Oxon.). These give a good contact impedance performance on clean skin for the duration of their lifetime (about 40 h).

The stimulator is easy to use and being so small and light may even by worn during working hours without embarrassment to the user. Electronic reliability is excellent and although the clinical trial has some way to run early results look promising.

References

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