

Notes on a recently constructed TL system

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Introduction

Some aspects of a recently constructed system for TL dating may be of interest to others about to design or modify such equipment. Although the system is a manual one, it served to test component designs destined for incorporation in a multi-sample automatic system. In outline the system follows the established layout, eg. Aitken (1985), of a heater within an evacuable chamber which may be filled with nitrogen for measurement of the glow curve, with the TL emission detected by a photomultiplier mounted on the chamber. The glow curve is recorded by a BBC Master computer which may also carry out data analysis and which controls the operation of the system. Figure 1a summarises the interfacing arrangement.

The photomultiplier may be removed and replaced by a shielded beta source ($^{90}\text{Sr}/^{90}\text{Y}$; 4 GBq) to apply a controlled radiation dose (90 mGy s^{-1}) to a sample in position on the heater. The source (Amersham International, type SIF1177) is stored at the centre of a cylindrical shield comprising an outer layer of lead 16 mm thick, an aluminium layer 23 mm thick and a 114 mm diameter core of perspex. The source is mounted on an aluminium wheel to provide easy rotation from the storage position to the exposure position. Although perspex was the preferred material close to the source, it would suffer from severe radiation damage immediately facing the surface of the beta source in its storage position, so a disc of aluminium is inserted there. The dose rate at the surface of the shield ranges from 5 to $10 \mu\text{Sv h}^{-1}$ reducing to about $0.7 \mu\text{Sv h}^{-1}$ at 0.5 m. Because of the weight of the shield, movement on to the top of the glow oven for exposure is motor assisted.

Heater assembly

The heater assembly is illustrated in figure 2. Linear increase in heater temperature with time is controlled - see figure 1b - by the circuit described by Mills et al. (1977), modified at its later stages to control a 20 kHz signal fed into an audio-amplifier (rated at 120W into 8 ohms, RS Components model MOS248) which in turn feeds the primary of a transformer wound on a ferroxcube core (100W E-cores, RS Components FX3730), on the lines described for the Risø automatic system by Bøtter-Jensen and Bundgaard (1978). The secondary of the transformer is made from solid copper and this solid secondary serves also as the mechanical mounting for the heater strip, as shown in figure 2. The knife edge shape of the two copper blocks onto which the heater is clamped was chosen to facilitate easy

heater replacement while ensuring accurate location. The nichrome heater strips, 0.125 mm thick, are prepared by bending on a former to an inverted U shape with a flat top 10 mm by 10 mm and a thermocouple is welded centrally underneath the flat top. The heater is pushed down on the copper knife edges and clamped in position. The knife edge shape prevents excessive conduction of heat away by the copper from the top surface of the heater strip, while locating the heater at a fixed position within the glow oven, that is at a fixed distance from the photomultiplier for constant efficiency of light collection. The inverted U shape is appropriate for an automatic system, resembling that used by Bøtter-Jensen and Bundgaard (1978) but possibly having a simpler fixing method.

Conclusion

The system described has been working satisfactorily for 18 months, principally with quartz fine grain deposits, and the features described have been built into an automatic system currently undergoing tests.

Acknowledgements

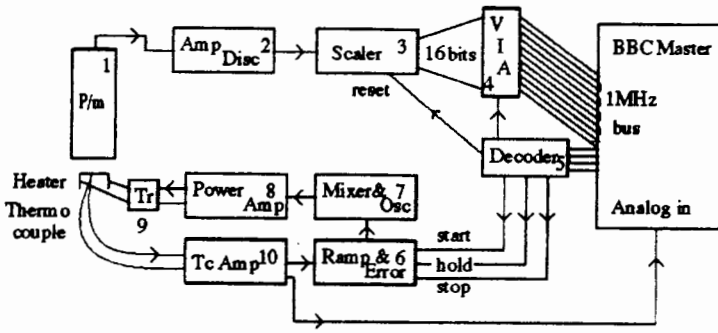
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References

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Figure 1a. Simplified schematic diagram of the interfacing control system.



1. RCA 8575 photomultiplier.
2. NE4676 fast amplifier and discriminator unit.
3. LM6365M pulse inverter driving two 74393 scaler chips.
4. 6522 VIA transferring data from scalers to computer.
5. 74154 decoder linking computer control to the scaler and the start, stop or hold of the heater temperature regulating circuitry.
6. Linear ramp and heater temperature error signal (Mills et al. 1977).
7. 8038 waveform generator and 1495 multiplier.
8. MOS248 120W amplifier module.
9. FX3730 E-core transformer.
10. 741 Op-amp.

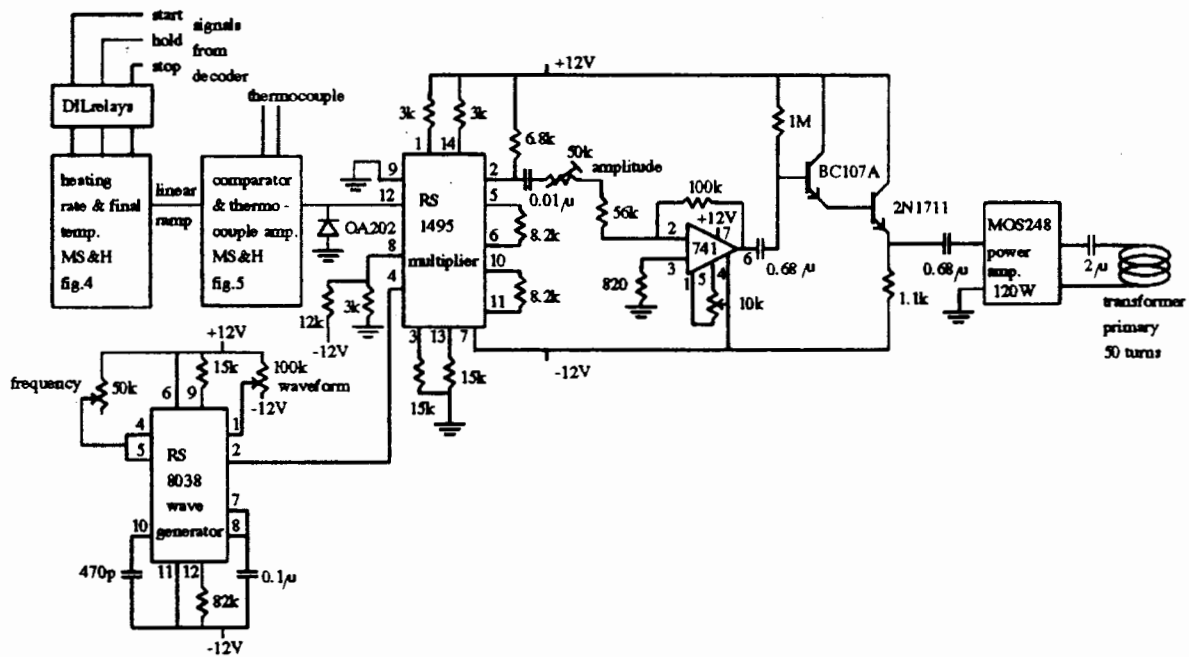


Figure 1b. Details of the heater control circuit, comprising blocks 6 - 10 of fig. 1a, showing the modifications and additions to the circuit of Mills et al. 1977, identified as MS&H in the diagram. The ramp generator of MS&H fig. 4 is modified only by replacing the 3 manually operated switches of the original which start, hold or stop the ramp by 3 DIL relays logic level controlled through a 7406 open collector buffer from the decoder (block 5 of fig. 1a). The comparator and thermocouple amplifier are as MS&H fig. 5. The components used with the wave generator and multiplier chips are shown followed by the voltage amplifying and buffering circuits used to drive the integrated power amplifier.

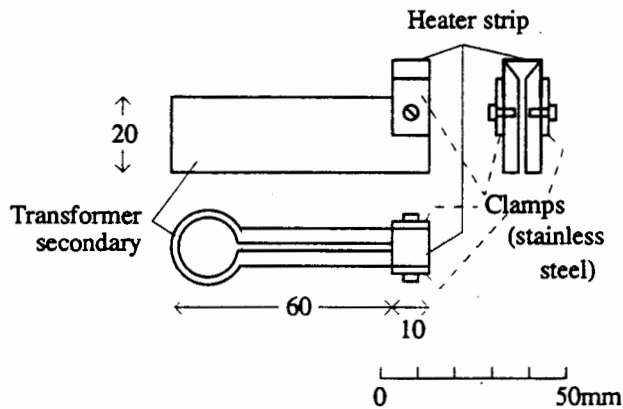


Figure 2. Scale drawing of the heater strip mounting and transformer secondary formed from copper.