A simple semi-automatic TL apparatus of new design

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General principles

Sixteen small cups lined up at regular intervals along the circumference of a polished metallic round plate (supporting platform; see Fig. 1) sit within the somewhat larger circular holes of an overhanging perforated metallic turntable (Figs. 1 and 2). As the turntable rotates it pushes all the cups along a circular path and placing them one after another on top of a titanium hot plate imbedded in the support and level with it. As each cup is centered over the hot plate the rotation stops, heating is applied and the TL measured. To make it less likely that the turntable interferes with the controlled temperature rise of the cup during the TL measurements two precautions are taken:

1. The hot plate is separated from the turntable by a fraction of a millimeter;
2. Once a cup sits on the hot plate the turntable reverses direction for a fraction of a second breaking physical contact with the cup.

Key Components

The apparatus consists of three major components.

1. A DC motor driving the turntable through a drive belt;
2. An underlying co-axial circular plate (slotted wheel) with equidistant slits along the circumference, one for each turntable hole;
3. Slotted opto-switch which turns off the motor when triggered by the passage of a slit (in the underlying co-axial circular plate) indicating that the cup is centered over the hot plate.

Construction

We modelled the apparatus on the equipment currently in use in our Laboratory, except that the 16 titanium cups (density 4.5 g/cm^3) have an external diameter of 13 mm and can accommodate about 10 mg of 100-160 μm size grains. The cups were polished with an alumina jet to help spread a monolayer of grains evenly over their surface.

The heating system is similar to one described in several publications (Bøtter-Jensen, 1988; Galloway, 1990). The temperature is measured with a chromel-alumel thermocouple in a stainless steel tube buried in the 1.5 mm thick hot plate. A 12 volt, 3 Watt, TAA-Crouzet motor rotates the turntable via a Binder-magnetic synchroflex drive belt (type M449C) at the rate of 4 RPM. The motor is powered through an integrated circuit UDN2953B which allows for forward and reverse motion. The arrival of cups on the hot plate is signalled by the plate slots which are detected by an Optoschmitt Honeywell HOA2001 slotted optoswitch.

Results

A run of 16 measurements with 12 mm cups containing about 10 mg of flint grains each yielded a standard deviation of 1.7%. An X-Y plot of the measurements is reproduced in Figure 3. The scatter of mean temperatures from 16 curves (±2°C) provides an indirect test of reproducibility of the temperature rise. In practice, when the paleodose of burnt flint is determined by the additive dose method only four cups per dose are used which yield TL glow curves with a precision of about ±1%.

Acknowledgments

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References

Botter-Jensen, L. (1988) The automated Risø TL dating reader system. *Nucl. Tracks and Radiat. Meas.* **14**, 177-180.

Galloway, R. B. (1990) Notes on a recently constructed TL system. *Ancient TL* **8**, 10.

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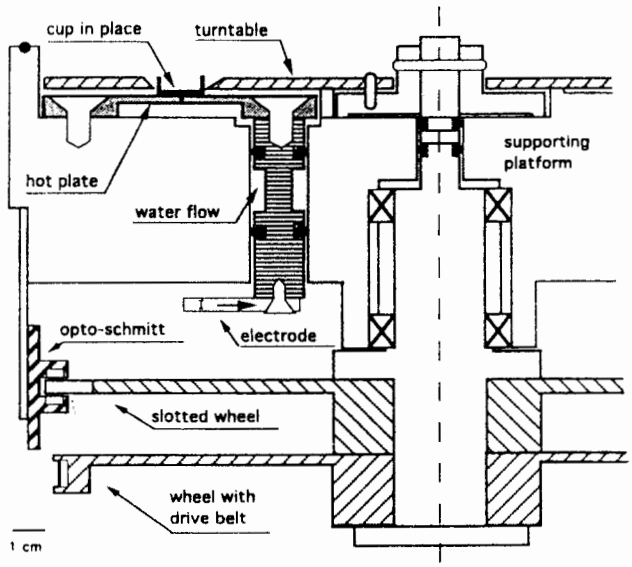
The described reader offers significant simplifications over other designs currently in use. Its main advantage lies in the elimination of additional hardware normally required to move the sample disk into contact with the heating plate. This, in principle, results in better vacuum integrity, and more precise alignment of the sample under the PMT over long periods of time. The design is also amenable to the addition of a beta source which would be useful for pre-dose measurements. the use of a 1.5 mm titanium heating plate may also minimize plate movement and warping during heating.

Figure 1.
Vertical cross section showing the principal components of the apparatus.



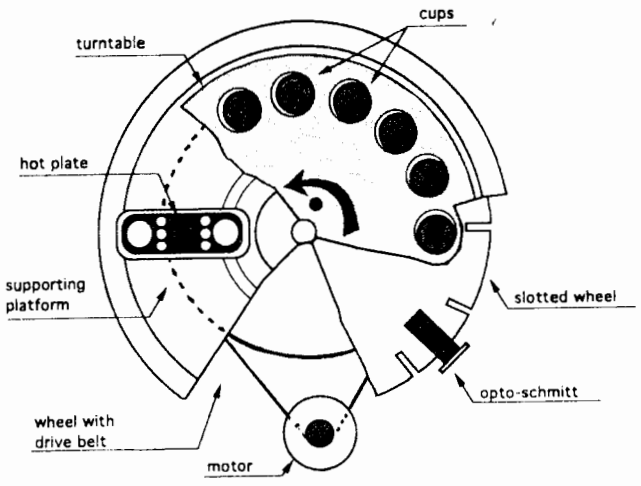


Figure 2.
Plan view of the apparatus showing the rigid supporting platform and the three synchronous rotating wheels (turntable, slotted wheel, and the wheel pulled by the drive belt). For the sake of clarity, the Optoschmitt is shown in the plane of the figure.

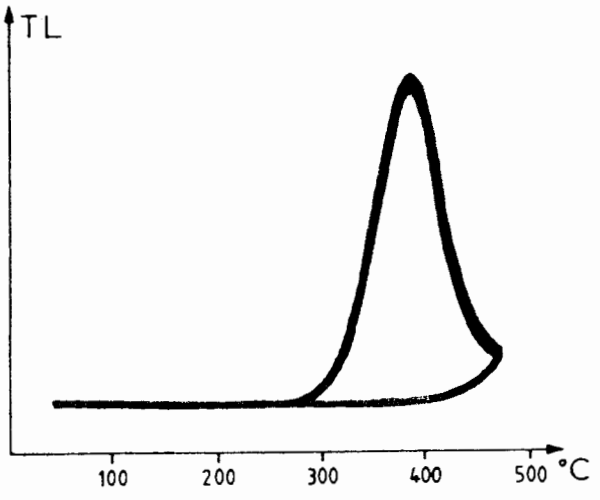


Figure 3.
TL curves of 16 cups containing 10mg aliquots of crushed burnt flint each. The standard deviation was ± 1.7%.