Regarding this Directory

This directory contains the data, and analysis of my only attempt to model (physically not numerically[1]) adiabatically a parameter variation using a pendulum whose bob is a permanent magnet in the presence of a very inhomogenous intensity smoothly changing magnetic field. However, this was not my initial intention when I collected this data. I, instead, was attempting to explore the lack of agreement with my method[2] of determining amplitude with the Smith method[3] that Bryan Mumford had found[4]. Using a similar apparatus he had found the Smith method showed an increase in the amplitude while my method a decrease when the “g” was reduced. The methods do agree when the amplitude is changed due to a change in the escapement’s drive. I don’t know the cause of the discrepancy, but suppose it may be due the the Smith method’s assumption that the pendulum is an harmonic oscillator. It is, of course, not, but a very good approximation for small angles and small variation in amplitude. This also applies to my method, which assumes the speed at bottom dead centre is linearly related to the amplitude. However, the deviation from harmonicity is exaggerated by the magnetic modulation. Evidently, the Smith method is more sensitive than the speed at BDC. As is seen from my graphs of amplitude, there is very good agreement between the two methods.

---

[1] I had numerically modeled (leap frog) a “g” variation previously, but thought the result was invalid, as I didn’t (don’t) know how to incorporate the energy transfers with the g field. I now think I can instead vary the rod length instead, tho one is also transferring energy to/from the pendulum. This is a question a more physically inclined person might assist me.

[2] Horological Science Newsletter 2007-4 pp. 29 ff. Note: Instead of measuring the speed with a photogate, I used the finite differences of the position generated by the LoggerPro software bundled with the Vernier interface I used in collecting the data from the Vernier RMS.

[3] supra 1997-5 pp. 24 ff.

[4] supra 2004-5 pp. 20 ff.

The Apparatus

The data shown is from the apparatus pictured except the bob was only the magnets. The pendulum drive is a pseudo-drive[5] from a domestic quartz clock pendulum, *i.e.* the pendulum had "nothing to do" with the clock! The quality of the drive is unknown, *i.e.* whether it observes the Airy condition, etc. A Pasco generator (pictured) applies the sawtooth current to the air core solenoid under the drive. As seen from the data graphs, it modulates the net force on the bob, being the equivalent of changing gravity for part of the trajectory[6]. In retrospect using one or two orders of magnitude less solenoid current might have reversed the non-adiabatic relationship of the amplitude (energy) and the frequency. I don't yet know what rate of change of the "g" parameter is necessary to observe the invariant: **E / frequency constant**. I calculate the g modulation to be approximately 0.53 Gal/s (5.3 mm/s*s/s) or approximately 0.05%/s. The nominal frequency was 5.2rad/s, or 1.2Hz. I will appreciate someone who's more familiar with Hamiltonian theory advising me. If I learn that the invariant applies to a driven pendulum[7] and the maximum rate of change is sufficient to detect with the Vernier Rotary Motion Sensor, I'll try again.

Note: I collected this data in 2011, June.

Remember, the squeaky person is more likely to get the cleyet.

bc, 2013 VII 09

---

[5] Kindly supplied by Bryan Mumford [Mumford Micro Systems - The Crackpot Inventor]

[6] The force observes a greater than fourth power reduction with separation of the magnets, both because they are dipoles and are co-axial only at BDC.

[7] The parameter change need not be constant, but time of change may necessarily be limited. arxiv.org/pdf/1210.4241.pdf