INTRODUCTION:
This simplest example of a coupled mechanical oscillator is an excellent demonstration tool in showing principles of transferal of energy. When properly calibrated, the Wilberforce pendulum goes back and forth between a purely up and down bobbing motion to a purely rotational motion. This curious motion is sure to excite the minds of students.
KIT CONTENTS:

Wilberforce pendulum mass
5 inch harmonic spring
1 brushed aluminum clamp with rod

GENERAL BACKGROUND:

Invented by Lionel Robert Wilberforce around 1896, the Wilberforce pendulum is a coupled mechanical oscillator. The mass of the pendulum is allowed to move with two degrees of freedom: the up and down oscillation and a rotation as in a torsional pendulum.

The movements are coupled due to the helical nature of the spring. The up and down motion causes the spring to wind and unwind slightly, giving the mass a small rotation. So each time the mass moves up, the spring winds and the mass rotates in one direction. When the mass descends and the spring stretches out, the unwinding of the spring causes the mass to rotate in the opposite direction. Each oscillation causes the mass to rotate a little more, until the mass is undergoing purely rotational motion and no longer bobbing up and down. It is in this way that the translational up and down energy slowly transfers to rotational energy.

Likewise, when the mass is rotating back and forth, the spring winds and unwinds. When it unwinds, the tension in the spring decreases and the mass drops as there is a smaller upward force pulling it up. Thus for each rotation it undergoes, the rotational energy starts to transfer back to translational energy and bobs up and down with greater amplitude, until it eventually transfers entirely back and undergoes purely up and down motion. At this point the process repeats.
Procedure

Recommended Equipment:
Eisco Base Retort Stand (CH0652)
Eisco Steel Rod, 100 cm (CH0657D)

1. Set up the Wilberforce pendulum as shown to the right. The apparatus needs hang from a support with at least 100 cm of clearance. A suggested support is a base retort stand and 100 cm steel rod. The included clamp can attach to any vertical rod up to 14 mm in diameter. Secure the clamp to the vertical rod using the thumbscrew, at least 100 cm above the surface of a table. Attach the mass to the helical spring by threading one end of the spring through the hole in the mass. Hang the other end of the spring in the notch in the rod.

2. The moment of inertia of the mass can be adjusted via the two adjustable masses on either side of the pendulum mass. The masses should be positioned such that they are equidistant along each threaded arm.

3. Pull the pendulum mass directly downward 5-8 cm without rotating the mass, then release. The mass will commence oscillation in the vertical direction, then for each consecutive up and down motion pick up a larger rotational component. The amplitude of the bobbing motion will decrease until the energy transfers completely to rotational motion. Then the rotational energy will transfer back to up and down oscillation, and so on.

4. If the pendulum does not completely transfer all of its energy, adjust the placement of the screws to change the moment of inertia. Move the adjustable masses inwards or outwards and try again. Remember to keep the masses equidistant along the threaded arms.