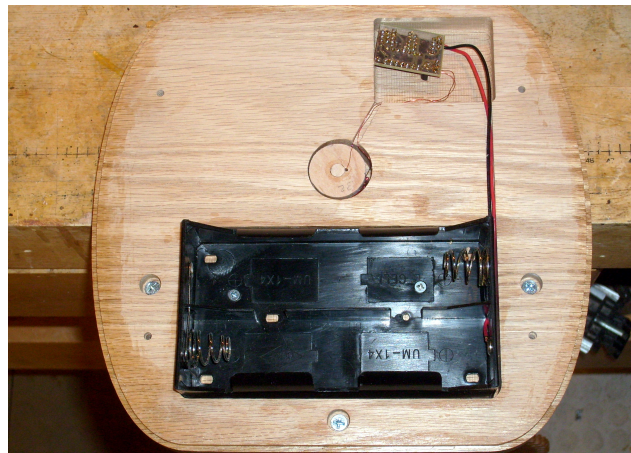


Electromagnetic Pendulum Drive Circuit



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This electromagnetic drive circuit uses a coil to detect a swinging pendulum with an embedded rare earth magnet and then applies a pulse of current to the coil to repel the pendulum and keep it moving.



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The coil bobbin that I used was made with a 1/4" diameter acrylic rod about 3/8" long. It was capped on each end with a circular acrylic piece 1/16" thick and about 1.25" in diameter. On this form, I wound 32 gauge magnet wire at about 1" diameter – I didn't count turns. The completed coil was about 50 ohms. The circuit should work with a variety of coils.

Operation

When a magnet of the correct polarity passes over the coil, it induces a negative, then a positive current in the coil. D1 shunts the negative current, and C2 filters unwanted oscillations. Op amp U1d amplifies the signal. The gain can be set by R1. Try setting it midway, and increase the gain as needed. The gain may need to be increased for longer pendulums, as a slow-moving magnet will not produce a very strong pulse.

Op amp U1a is configured as a comparator. When the voltage at the coil rises sufficiently, the op amp output goes high.

This voltage pulse is passed onto op amp U1c, also a comparator, and its output goes low. This turns on transistor Q1, which sends current into the coil.

The voltage on C5 is gradually bled off by R8. When it returns close to zero, the op amp switches and its output goes high, shutting off Q1 and the current into the coil. The driven pulse width can be adjusted from virtually nothing to about 60 mS by trim potentiometer R8. (To conserve power, adjust R8 counterclockwise as far as possible while keeping the pendulum active.) D1 also protects Q1 from voltage generated in the coil when the current is shut off. The corresponding drop in voltage across the coil turns off U1a, whose output is passed on through C3 as a negative pulse. D5 largely snubs this negative pulse.

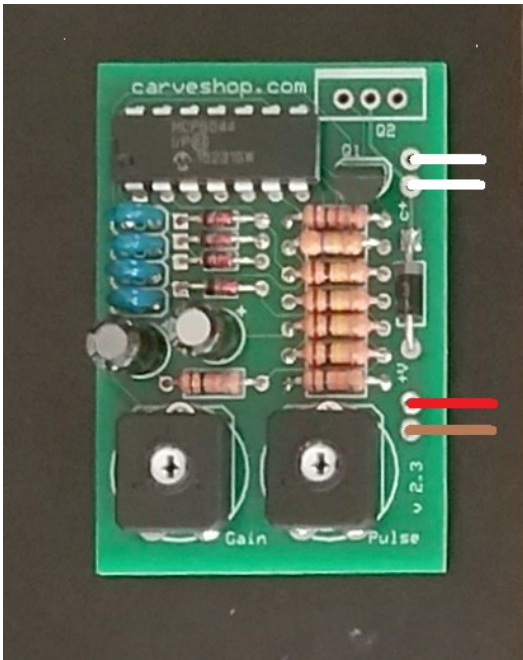
As the driven pulse width is tuned narrower to conserve power, it's possible that the passing magnet may still be close enough to induce a voltage across the coil after the pulse into the coil has turned off. This could (and did for me) induce a second, undesired pulse into the coil. U2c is set up much like U1b but with a longer time constant. When triggered, it pulls the input to U1a high, and holds it there until the magnet is far away. This masks any voltage that might be generated by the moving magnet and prevents a second, undesired pulse into the coil.

The circuit may be operated by two, three, or four alkaline cells (3-6V).

For a higher-power circuit, replace the low-power op amp with a Texas Instruments TLC 2274 and replace Q1 with a mosfet Fairchild FQP27P06. The circuit may then be operated with up to a 12 volt supply.



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Polarity

The polarity of the magnet and coil should be such that a negative pulse is induced first. You can determine the correct polarity by operating the pendulum with a short pulse, then swap polarity of either coil or magnet. Whichever orientation yields the largest swing angle is correct. (The circuit may not work at all with incorrect polarity.)

