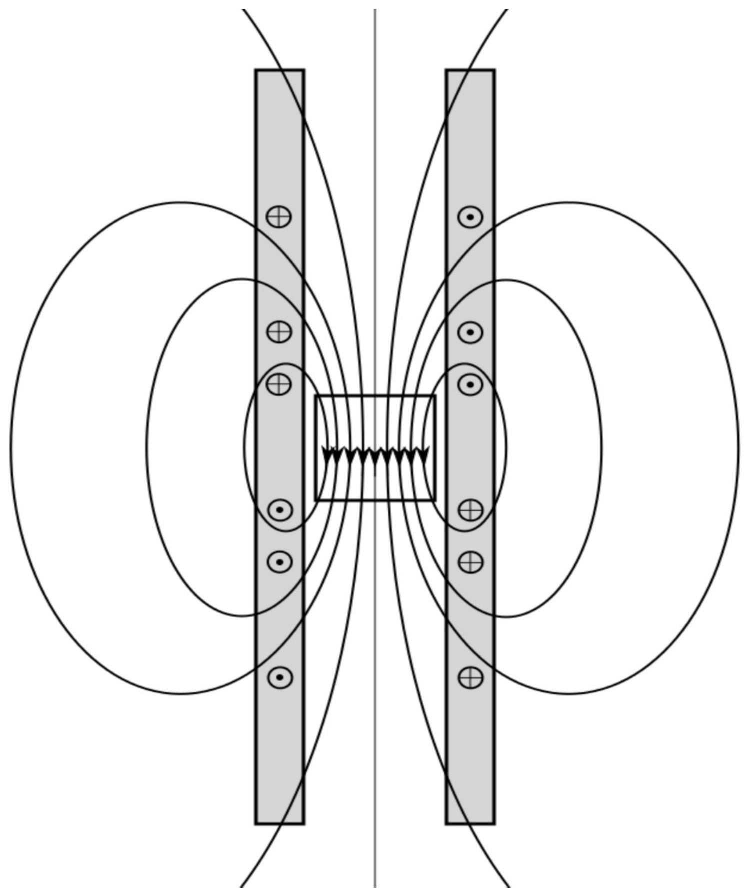
Magnet Falling Inside Aluminum Tube

The effect of Eddy currents becomes very obvious in the following demonstration where a powerful magnet is dropped inside of a slightly larger aluminum tube. In this case, the magnet is a 25.4 mm-diameter neodymium magnet that is 25.4-mm long and has a 6.35-mm dia central hole (the hole is not important). The aluminum is an extruded pipe of 6101-T61 aluminum with a 26.67-mm ID and 33.40-mm OD.

As the magnet falls vertically through the pipe, currents are induced in the pipe wall by the changing magnetic flux. At the lower end of the magnet, the currents produce an opposing magnetic field that slows the magnet's fall. The same phenomenon in reverse tugs at the upper end of the magnet which also acts to slow its fall. This is shown in the following diagram.



In the drawing, the north pole of the falling magnet is pointed downward and its magnetic field lines are illustrated. The circular induced currents in the walls of the aluminum tube are shown by the arrow heads and tails.

The north pole of the magnetic field produced by the lower induced current is upward, pushing against the north pole of the falling magnet. The north pole of the magnetic field of the upper induced current is pointed downward, pulling at the south end of the falling magnet. Both currents act to retard the fall of the magnet causing it to fall at a nearly steady rate of only 0.046 m/s. It therefore requires 20 s to fall through the 0.91-m long tube whereas free-falling that same distance would only require 0.43 s.

The induced magnetic fields necessarily oppose the falling motion of the magnet. If it enhanced the rate of fall, this device would violate conservation of energy and could be used as a source of unlimited energy.