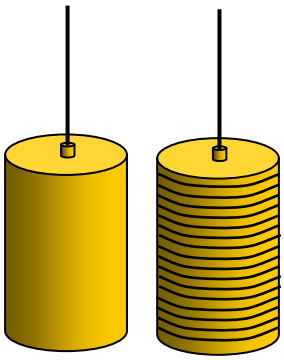
# TAP 414-10: Further eddy current demonstrations

## Eddy Currents

This experiment is a very simple way of showing eddy current damping

### You will need:

- ✓ pile of small copper coins
- ✓ copper cylinder
- ✓ thread
- ✓ retort stand
- ✓ eclipse major magnet



### What to do

Suspend a copper cylinder from a thread so that it hangs between the poles of a large permanent magnet (flux density about 0.5 T). Twist the thread so that it oscillates about a vertical axis when released. The motion of the cylinder shows considerable damping because of the eddy currents set up within it. Now repeat the experiment using a pile of small copper or brass coins taped together.

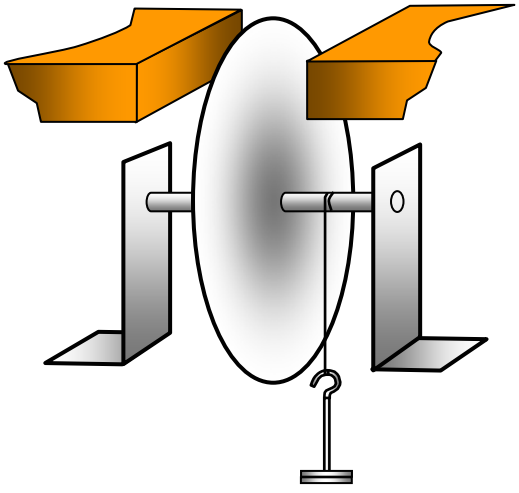
### You have seen

The copper coins come to rest more slowly; the damping is much less because the gaps between the coins only allow much reduced eddy currents to flow in the stack

## Electromagnetic brake

### You will need:

- ✓ large horseshoe magnet or a pair of Magnadur magnets on steel yoke
- ✓ aluminium disc on horizontal axle
- ✓ cotton
- ✓ slotted masses and hanger



### What to do

Spin a non-magnetic metal disc between a pair of Magnadur magnets mounted vertically about a cm apart with opposite poles facing each other. The disc can be made to spin in a vertical plane by tying a piece of cotton to the axle of the disc and passing it over a pulley to a weight that is free to fall.

### You have seen

Spinning a non-magnetic metal disc shows eddy current damping. As the weight falls it accelerates continually without the magnets but reaches a terminal velocity when they are in place.

## Aluminium plate under a swinging magnet

### You will need:

- ✓ large horseshoe magnet
- ✓ aluminium plate
- ✓ retort stand
- ✓ thread

### What to do

Suspend a bar magnet by a thread so that it hangs horizontally above an aluminium plate and start the magnet swinging

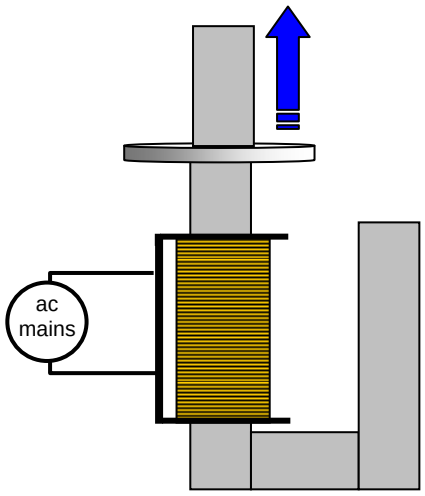
### You have seen

The magnet will soon come to rest because of the induced currents in the plate. This is a simple example of eddy current damping

## Jumping ring and solid carbon dioxide

### You will need:

- ✓ demountable transformer
- ✓ aluminium ring
- ✓ mains coil and power
- ✓ retort stand
- ✓ solid carbon dioxide (optional)




The Jumping Ring

### Safety

The coil used here must have been prepared for use on the mains. The insulation must be to mains standard and the 4mm connectors replaced with a proper mains connector.

### What to do

(a) The core of a demountable transformer is opened, a mains coil connected to the ac mains and used as the primary and an aluminium ring as a secondary. The crosspiece is placed vertically on the arm round which the ring is slipped. Switch on the power.

The ring can be cooled by placing it in liquid nitrogen or solid carbon dioxide if the nitrogen is not available.

(b) Put the mains coil round the bottom of a retort stand using an aluminium ring to act as the secondary. As before you can cool the ring in solid carbon dioxide.

(c) An interesting extension to this experiment is to use a taller core round which to place the ring.

## What you have seen

(a) Switching on the current shoots the ring into the air

The repulsion between the magnetic fields produced by two electric currents is shown by this experiment with the aluminium ring.

Eddy currents induced in the ring form a magnetic field which is the same direction as that in the coil and so the ring is repelled

As a problem for the thinking students ask them what happens with a dc supply.

The ring can be cooled by placing it in liquid nitrogen or solid carbon dioxide if the nitrogen is not available.

(b) This increases the height risen by lowering the resistance of the ring and so increasing the size of the induced current in it. You might get some heating problems in the retort stand due to eddy currents set up within it so maybe it is better to use a section of a laminated core as the vertical part.

(c) The force on the ring acts for longer and so the ring rises higher when the current is switched on (A greater impulse $Ft = mv$).

## External Reference

This activity is taken from Resourceful Physics