

Tap 414-9: Introducing eddy currents

Here you will look at changing magnetic fluxes inducing currents in circuit elements of magnetic and electric circuits. These currents generally dissipate energy, leading to inefficiency.

You will need:

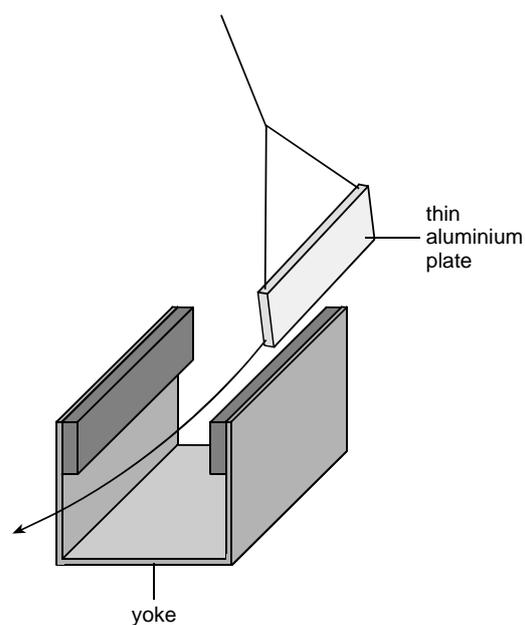
- ✓ 3 mm thickness aluminium plate
- ✓ scissors
- ✓ thread
- ✓ adhesive tape
- ✓ retort stand, boss and clamp
- ✓ large horseshoe magnet
- ✓ large coil of insulated copper wire
- ✓ copper tube
- ✓ ceramic button magnet (Neodymium is best)

An overview

You will be making some general observations about eddy currents. For each experiment, you should seek an explanation of what you see in terms of these induced currents opposing change.

Eddy current braking

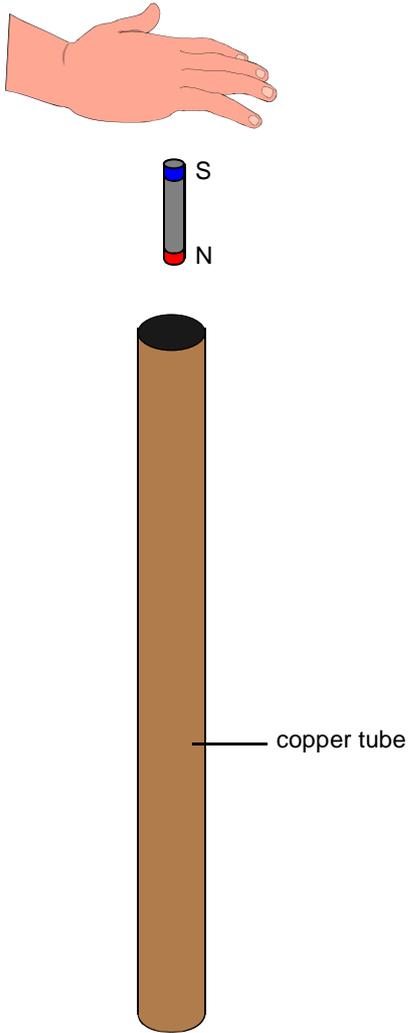
Set up this pendulum.



1. As the aluminium pendulum swings through the magnet what do you observe?
2. How can you explain this effect? Remember that aluminium is not a magnetic material.
3. As the pendulum hangs, draw the magnet quickly past it. You may observe that the pendulum moves slightly.
4. Take the coil of copper wire and suspend it instead of the pendulum. Approaching it with the magnet should once again cause movement. How do you explain this?

This effect is important in so called 'shaded pole motors'.

The copper pipe



1. Clamp the copper pipe. Drop the magnet down the pipe.
2. What do you observe?
3. How do you explain this?

What you have seen

1. When a conductor moves in a magnetic flux it experiences a force which opposes the movement.
2. This force is due to the induction of eddy currents in the conductor.
3. The direction of the force demonstrates Lenz's law.

Practical advice

An extension of the pendulum experiment is to look at what happens if the aluminium has slits cut in it. Such a demonstration can lead to discussion of transformer lamination. It is best if the experiment is set up with magnets that cause the pendulum to stop after a few swings rather than straight away.

The copper pipe is an excellent experiment: simple, startling and memorable. It brings a smile to the face of most students. Having a piece of unmagnetised steel pipe of the same size is good for comparisons. If you have a very long piece of tube and somewhere to use it, the time taken to fall can be impressively huge. Further exploration of the origins of the retarding force can be done by hanging the pipe from a newton-meter whilst dropping the magnet down the tube.

If 'magnetic viewing film' is used you will see the magnet 'move' in the tube.

As a continuation, you could also compare it to a glass tube.

Alternative approaches

You may have a mounted aluminium disc; if you do not, it is well worth having one made. Such a disc can be used instead of the pendulum and makes the discussion of induction braking easier since the disc looks as if it is a wheel. This disc could also be used in induction motor experiments so it would represent a good investment. The jumping ring could be used here, but you may like to keep it until later to make an impact for induction motors.

Social and human context

Retarders (induction brakes) are fitted to most large vehicles. Students may have followed lorries that seem able to go at a suspiciously constant speed downhill. Regenerative braking in trains is important. Here's an application perhaps worth mentioning alongside the copper pipe (although very tangential). If you place a large magnet outside you can hear the magnet fall and then suddenly stop. A medical application of fine suspensions, called liquid magnets, is to introduce them into the blood and use a magnet to stop them exactly where you wish a clot to form.

External reference

This activity is taken from Advancing Physics chapter 15, 20E