6. Lenz´s law

Direction of induced current: Lenz's law

Figure 2b shows the effect of pulling the magnet in figure 2a out of the coil. The direction of the induced current has now reversed. In this, and the previous case, the direction of the induced current is given by a law first stated by Heinrich Lenz in 1834:

An induced current always flows in a direction such that it opposes the change producing it.

In figure 2a for example, the motion of the magnet is opposed because the induced current turns the coil into a weak electromagnet with its N pole repelling the approaching N pole of the magnet. In figure 2b, the motion of the magnet is again opposed. This time, the coil attracts the N pole of the magnet as it is pulled away. Knowing which ends of the coil have become N and S in each case, the direction of the induced current can be worked out using the right-hand grip rule given on page 281. Imagine your right hand gripping the coil so that your thumb is pointing towards its N pole; your fingers indicate the direction of the (conventional) current in the turns of the coil.

Lenz's law is an example of the law of conservation of energy. A force must oppose any motion that produces a current because work must be done if electrons are to gain energy.

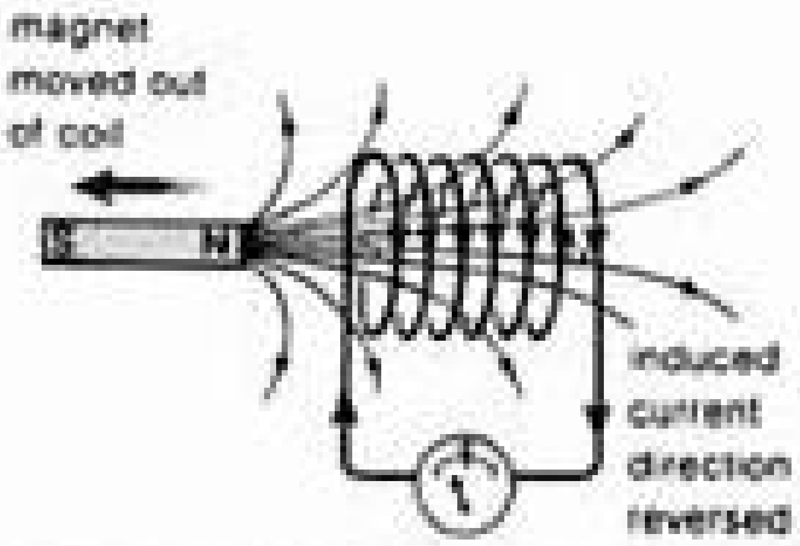

Figure 2b As the magnet is removed the induced current direction is reversed

Eddy currents

If the aluminium disc in figure 5a is spun round fast, it may take quite a long time for frictional forces to bring it to rest. If however the disc is spun between the poles of a strong magnet as in figure 5b, it stops moving almost immediately. Being made of aluminium, the disc conducts well, and currents are induced in it as it moves through the magnetic field. These currents are known as **eddy currents**, and they have a magnetic effect which, by Lenz's law opposes the motion of the disc.

The coil of the moving-coil galvanometer is wound on an aluminium frame, as described on page 299. The damping effect on the coil's motion is caused by eddy currents which are induced in the frame as it turns through a magnetic field.

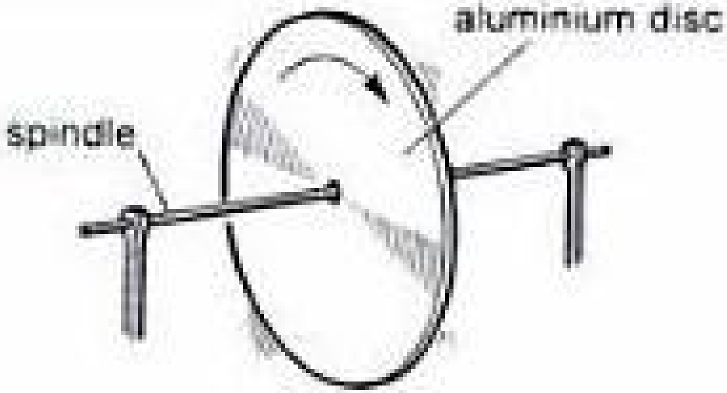

Figure 5a

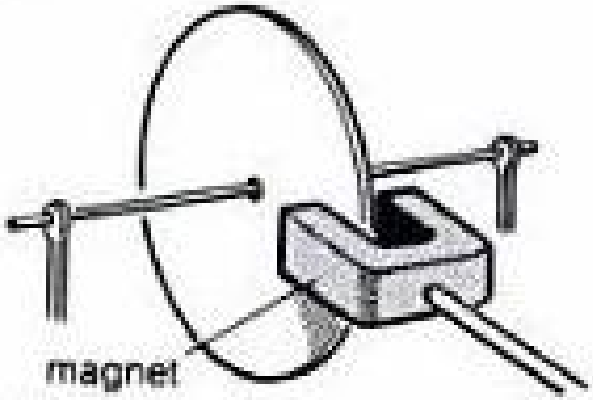

Figure 5b

Figures 5a, 5b Induced eddy currents rapidly bring a spinning aluminium disc to a halt

Moving-coil microphone

When you speak into a moving-coil microphone as shown in figure 6, sound waves set the diaphragm vibrating. This moves a small coil backwards and forwards through the magnetic field from a cylindrical magnet, and a small alternating current is induced in the coil as a result. When amplified (made larger), the current can be used to drive a loudspeaker.