Dynamic Magnetization Movement in Magnet Motors

Here are some considerations for a magnetic motor using disc magnets such as those used by Brady, Yildiz and others. Figure 1 shows a magnet in cross section with the lattice dipoles shown as red arrows. It is known that the conduction electrons are spin-polarized, these are shown as blue arrows. Although the latter are jiggling about at Fermi velocity their spatial distribution is uniform.

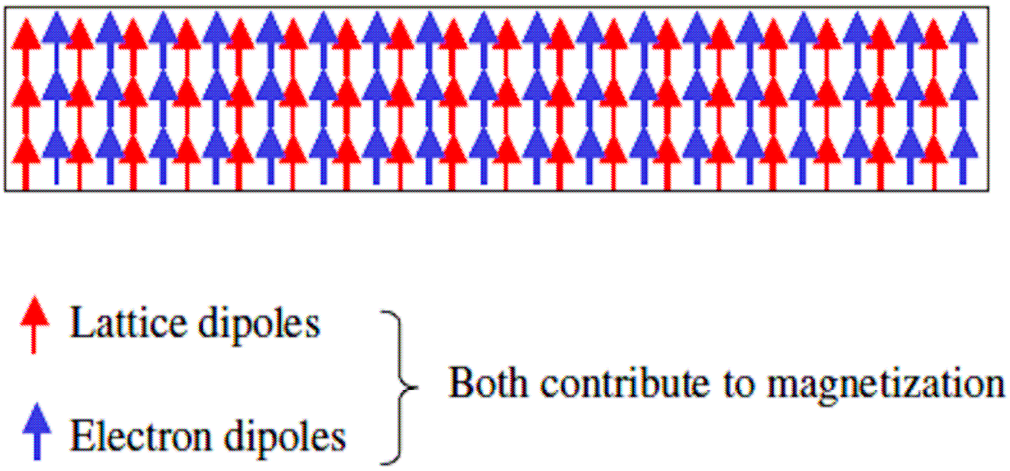

Figure 1. Disc magnet showing uniform dipole distribution.

Figure 2 shows two disc magnets with the top one passing over the other at velocity v into the paper. The **E** = **v** × **B** induction (Fleming's RH rule) within each magnet will cause the mobile conduction electrons to gather at one side.

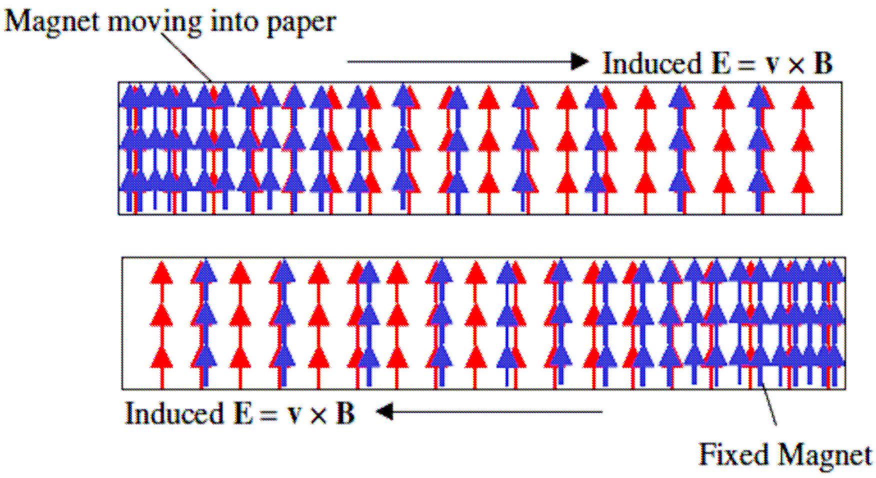

Figure 2. Disc magnet's passing each other.

Thus the magnetization is no longer uniform. Note in this configuration (magnets attracting each other) the magnetizations move in opposite directions. If the magnets are in repelling configuration we get the situation seen in figure 3.

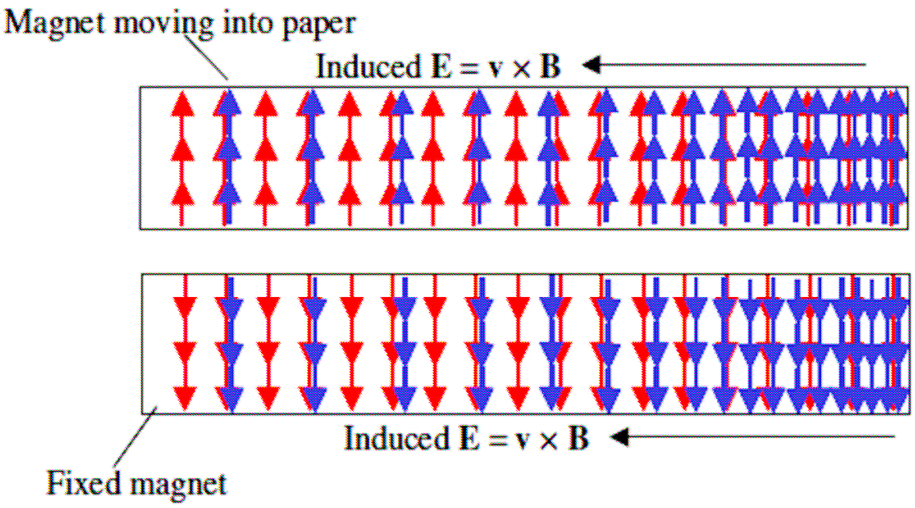

Figure 3. Repelling magnets passing each other

If we have a disc magnet moving over a series of fixed magnets with alternating polarizations, the magnetizations move as depicted in Figure 4.

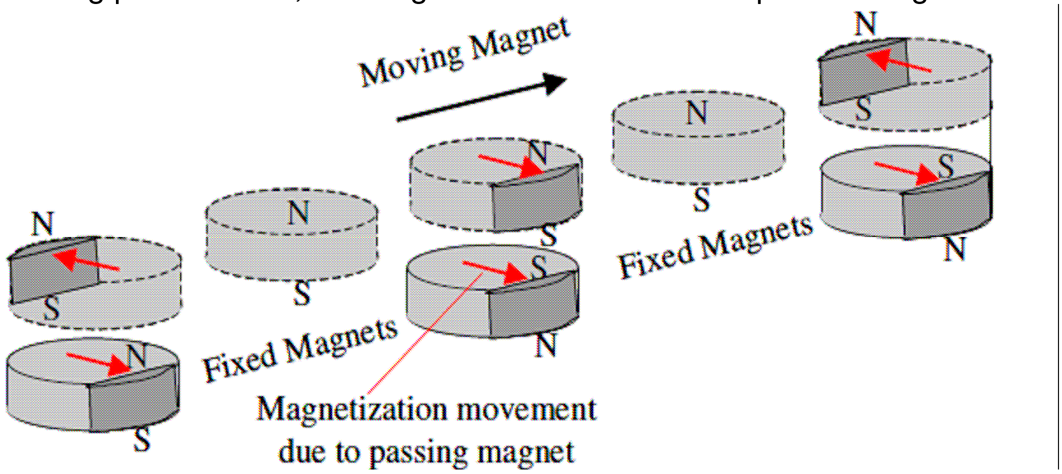

Figure 4. Magnet moving over alternately polarized fixed magnets

Note the effective position of the moving magnet wobbles from side to side. To make use of this feature we can supply additional fixed magnets off the center-line as shown in figure 5.

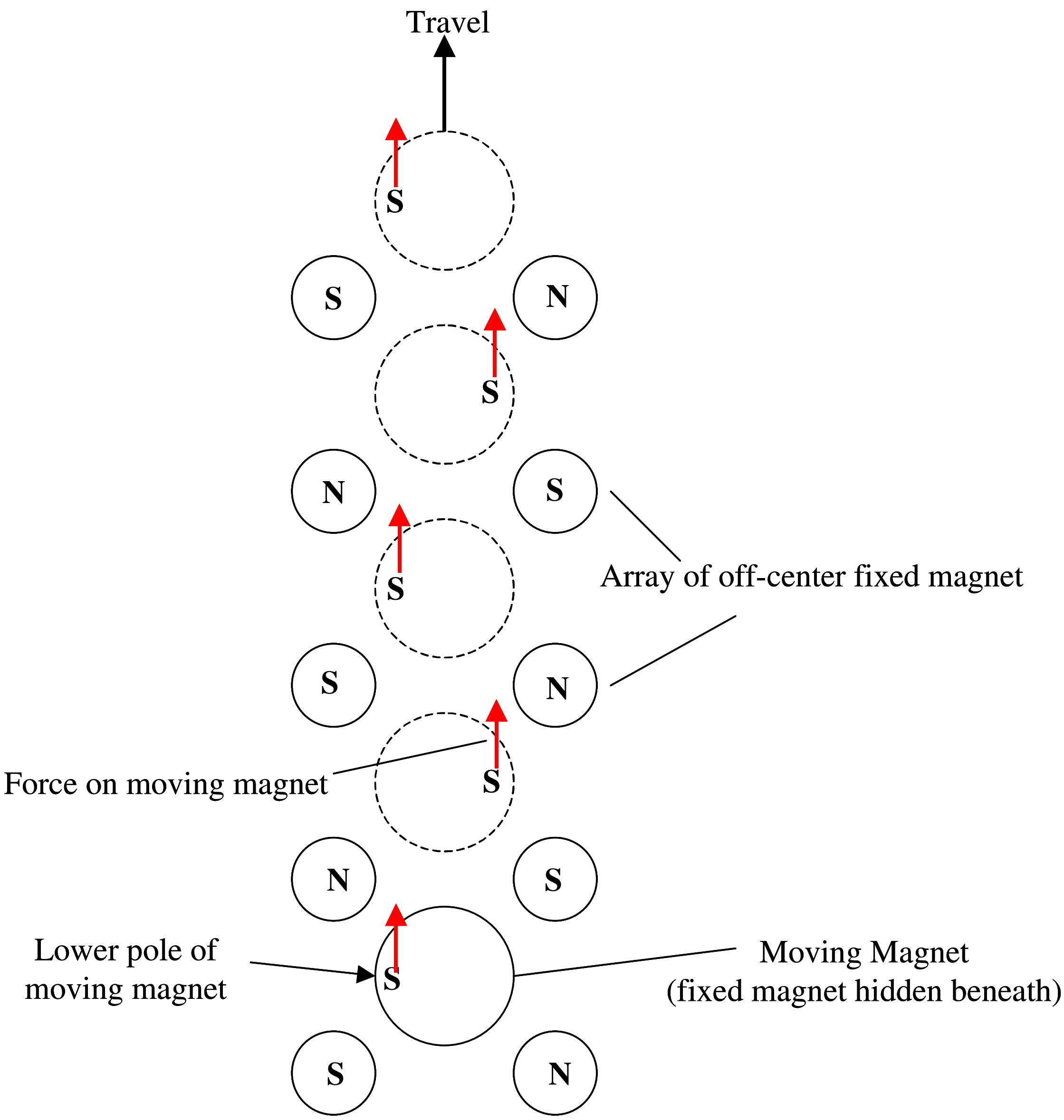

Figure 5. Complete array for obtaining net force.

The effective side-to-side movement of the moving magnet puts it in positions such that it obtains a rectified force waveform in one direction. Note that in figure 5 we can only see the top pole faces of the moving magnets, and the series of fixed magnets along the center-line are not seen as they are obscured by the moving ones.

The above may explain why magnet motors work, but it should be realized that for practical motors the amount of magnetization moved across the disc diameter is very small. It can be increased by providing capacitive coupling to shorted electrodes as shown in figure 6. This produces increased values of surface charge and since the charges are spin-polarized we obtain an increased magnetization shift. This surface effect is known as the Magneto-electric Effect. It can be further enhanced if the dielectric is ferroelectric.

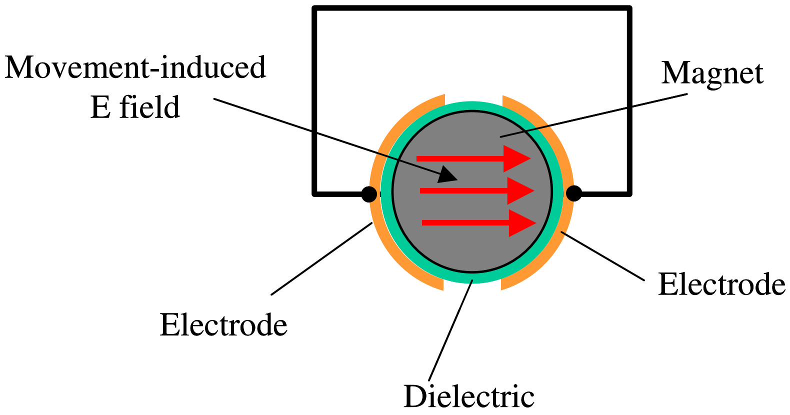

Figure 6. Capacitive coupling provides increased surface magnetization

If disc magnets are glued within an aluminum block then capacitive coupling through the glue will create the Magneto-electric Effect, figure 7.

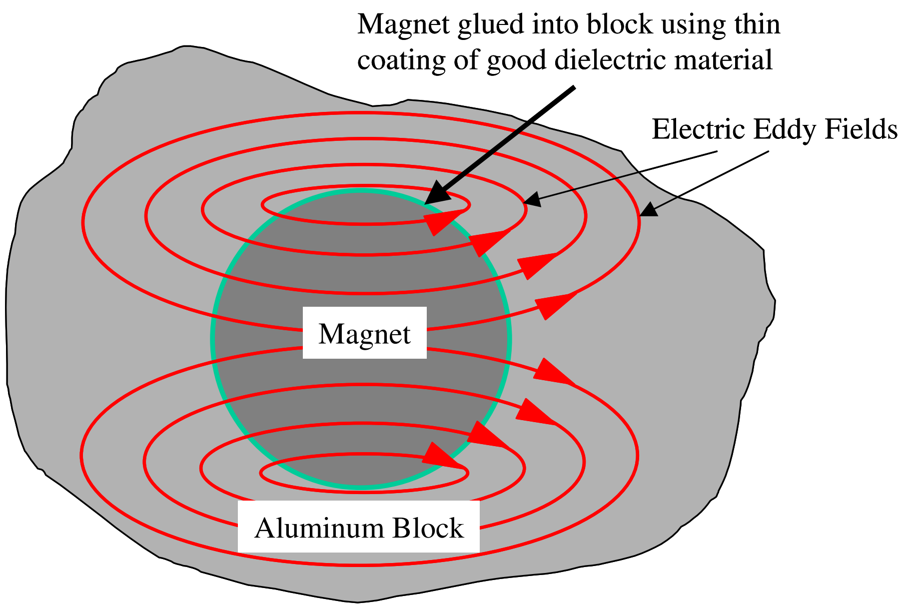

Figure 7. Magnet adhesive will allow the Magneto-electric Effect

Note that it is essential to use an adhesive that has good dielectric properties and is a good insulator. Any conduction path into the aluminum will destroy the surface charge hence also the surface magnetization. Note also that the motional induction due to passing over another magnet creates closed electric fields that would otherwise induce eddy currents, and those closed lines further enhance the surface charge at the dielectric interface.

If this theory is valid it could explain why magnet motors are notoriously difficult to replicate, since the importance of electrical isolation and dielectric properties of the adhesive is not realized by the constructors.