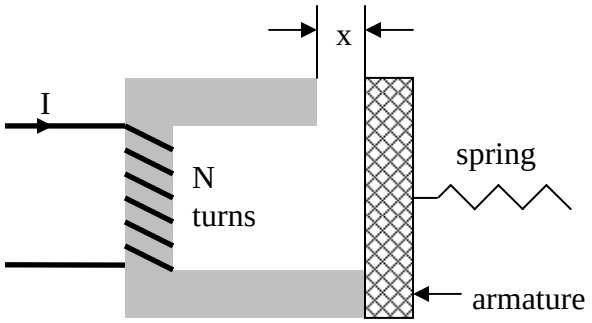
Tutorial Sheet 4 – Self Excited Actuator

1. A dc "choke" inductor has an inductance given by:

$$L = 3 + \frac{0.03}{x} mH$$

Where x is the length in metres of the airgap in the inductor core. If x = 2mm, calculate:

a) the energy stored in the inductor when carrying a dc current of 3A (81mJ)
b) the force across the faces of the airgap at the same current (33.75N)



2. The figure shows the configuration of a rudimentary form of relay in which the only significant reluctance is the airgap of length x and cross-sectional area A. Derive an expression for the coil inductance and hence show the magnitude of the force on the hinged armature is given by:

$$F = \frac{\mu_0 A N^2 I^2}{2x^2}$$

For a particular relay N = 1000 turns, A = 120 mm_2 and x = 5 mm when the armature is in the open position and x = 3 mm when the armature is in the closed position. If the spring exerts a constant force of 3N, calculate the current required to close the relay and the current at which it will re-open. ($L = \mu_0 A N^2 / x$, I ≥1A, I≤0.6A)

Why are the two currents not equal?
Why is this effect desirable in a relay?