Magnetic Braking
And
Eddy Currents

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Purpose

The purpose of this experiment is to examine some effects of electricity and magnetism. Specifically, measuring a magnetic field, studying eddy currents, and the force between currents and a magnet.

Introduction

A magnet dropped through a tube that is looped with a conducting wire, will induce a current in that wire. This current in turn produces a magnetic field, that opposes the falling magnet. As the speed of the falling magnet increases, the magnetic field due to the current increases, until the force of gravity on the magnet is balanced by the force from the magnetic field, and a terminal velocity is reached. By measuring the strength of the magnetic field of the magnet, one may deduce this terminal velocity, and compare with measurements.

Procedures

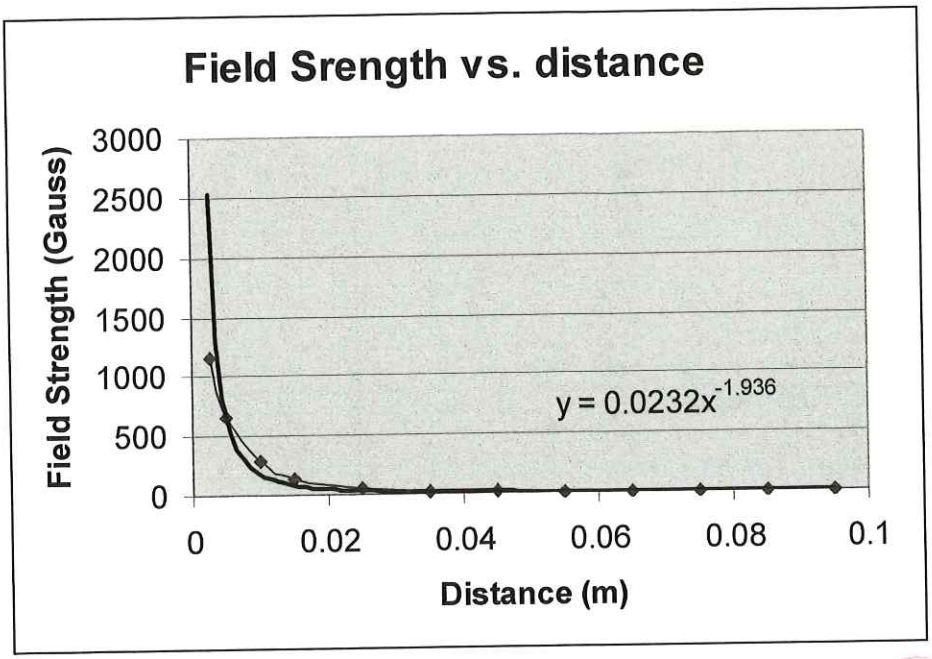
The field of a small button magnet will be measured at several distances, to determine the strength of the magnet. These results will then be used to deduce the results of other experiments that may be performed.

Results

Table 1: Field Strength of Button Magnet

Distance (m):	0.095	0.085	0.075	0.065	0.055	0.045	0.035	0.025	0.015	0.01	0.005	0.0025
Field Strength:	0	0.7	1.7	3	4.9	9.5	19.8	46.9	149.4	277	690	1220
(Guass)	1.9	2.4	3.2	4.2	6.4	10.9	19.8	44.1	126	245	569	1017
	1.8	2.3	3.1	4.1	6.3	10.7	20	45.7	130.9	261	589	1077
	2	2.4	3.1	4.1	6.4	10.5	19.1	45.2	129.2	282	621	1177
	1.9	2.5	3.2	4.2	6.5	11.3	21.3	50.4	149.9	328	796	1290
avg:	**1.52**	**2.06**	**2.86**	**3.92**	**6.1**	**10.58**	**20**	**46.46**	**137.1**	**279**	**653**	**1156.2**

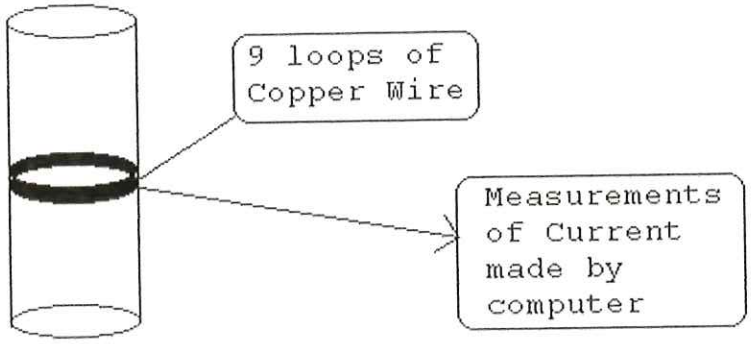
The average field strengths are plotted against the distance from the magnet on the next page.



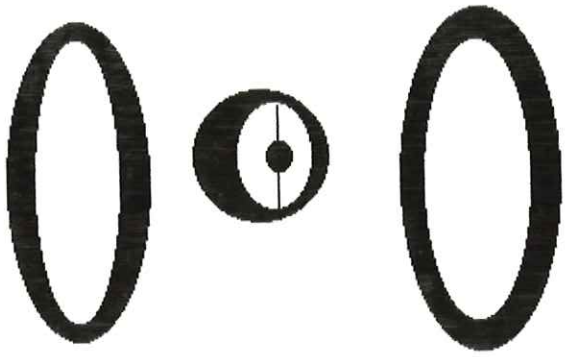
As the graph shows, the button magnet has magnetic field strength of $\mathbf{M} = (0.0232/r^2)\hat{\mathbf{r}}$.
The magnet had a diameter of 12.5mm±0.05mm, with a thickness of 6.0mm±.05mm.

The Button Magnet:

Some set ups that I didn't actually use included this one:



This set up was to involve dropping the magnet through the tube, and measuring the current induced in the copper wires around the tube. This should have been dependent on the number of loops of copper wire around the tube. There were 9 such loops in this case.



This experiment above was to involve suspending the button magnet in the centre coil of 3400 turns of copper wire, centred itself midway between two larger loops each with a 15.5cm radius. The two larger loops also had 130 loops of copper wire. The two rings were spaced by 15cm.

This set up would allow one to determine the magnetic moment of the button magnet. A known magnetic field would be produced by the larger rings. The centre coil would be hooked up to an oscilloscope, and would measure the oscillations of the suspended button magnet. The frequency of oscillations would have been dependent on the button field, and the supplied field, and by varying the supplied field, the button field would be determined.

Discussion

This partly finished lab serves more as a shrewd outline to experiments with magnets and magnetic fields that could be performed by others in the future.

Conclusions

The only real conclusion to this lab, is that I should have put more work in to it earlier in the year. But it had been determined that the strength of a magnetic field is inversely proportional to the square of the distance away from the source.