Potential Difference Observed with Magnetic Field Lines

Ionel DINU, M.Sc.
Physicist, Teacher of Physics
LinkedIn : https://ro.linkedin.com/pub/ionel-dinu/34/906/744
e-mail: dynuionel@yahoo.com
(Dated: April 20, 2017)

Abstract

Following a theory to be detailed in a work to be published in the near future, an experiment was planned to see whether the potential difference between two points of a current-carrying straight wire can be observed in the magnetic field lines produced around the wire by the electric current. Direct observation seems to show that there is a crowding of the magnetic field lines at the negative side of the wire compared to the positive side.

Introduction

In the quest for a better mechanical theory of the magnetic field based on the liquid aether, the author has developed a theory (to be published in the near future) that pointed towards an experiment to check whether there is any difference in the density of magnetic field lines at two different points of a current-carrying wire due to the points being at a different potential.

Background

The pattern of magnetic field lines of a current-carrying straight wire is known to consist, in a plane perpendicular to the wire (a.k.a. equatorial, or azimuthal), of circular lines of different diameters centered at the wire, as shown in the figure below:

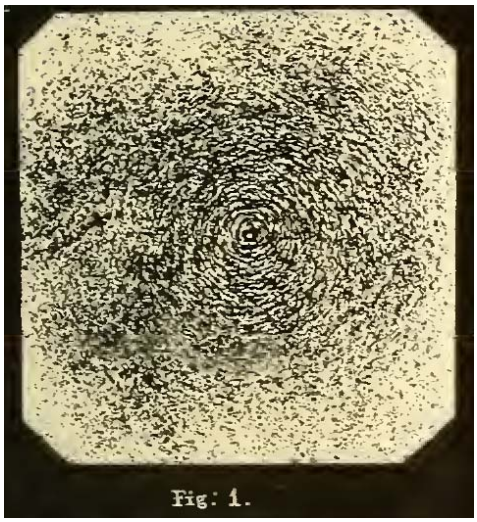


Fig. 1.

When observed along the wire, the lines of magnetic field are not circular but straight, perpendicular to the wire, and seem to correspond to the side-view of the circular lines shown above.

The following figure shows the pattern observed along a current-carrying wire:

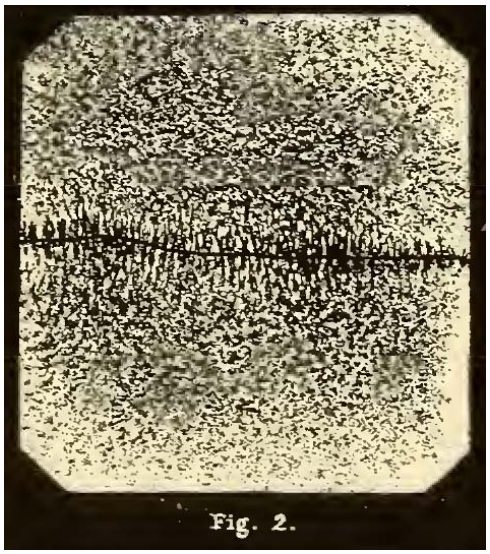


Fig. 2.

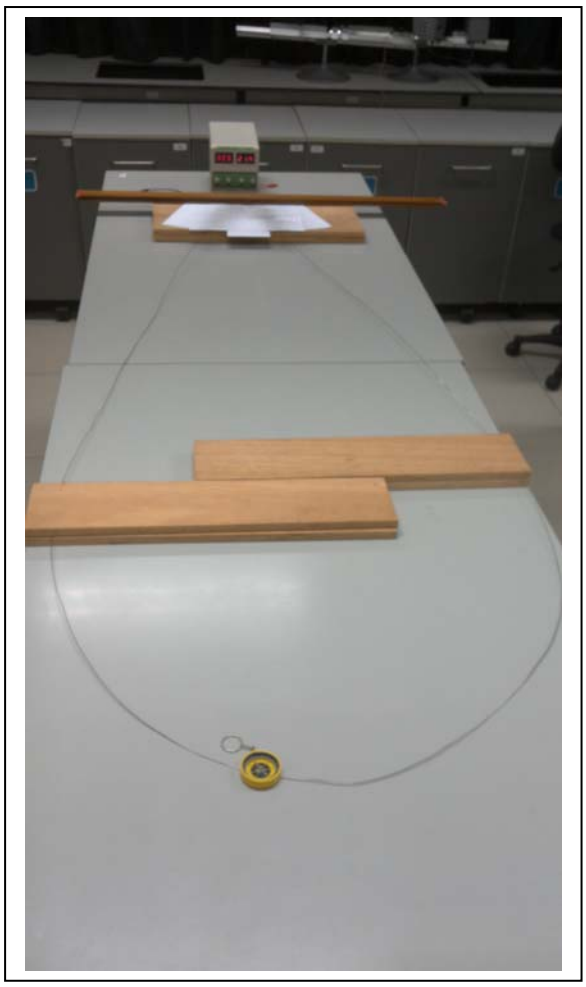
The figures are taken from the article *Magnetic Figures illustrating Electrodynamic Relations*, Silvanus P. Thomson (Phil. Mag., Vil. VI, 5th Series, Jul-Dec 1878, pp. 348-353, Plates VI and VII at the end of the volume).

The Experiment

In the present experiment, the author used a nichrome wire to observe whether there is any difference in the density of magnetic field lines along a current-carrying straight wire. Such a difference was expected between points along the wire situated at great potential difference. The points of greatest potential difference along a wire are naturally close to the terminals of the power supply.

The wire used was 4.5m long, 1 mm diameter, 7.7 ohms, in a circuit with a d.c. power supply that delivered a current of 3A at a potential difference of 21 V.

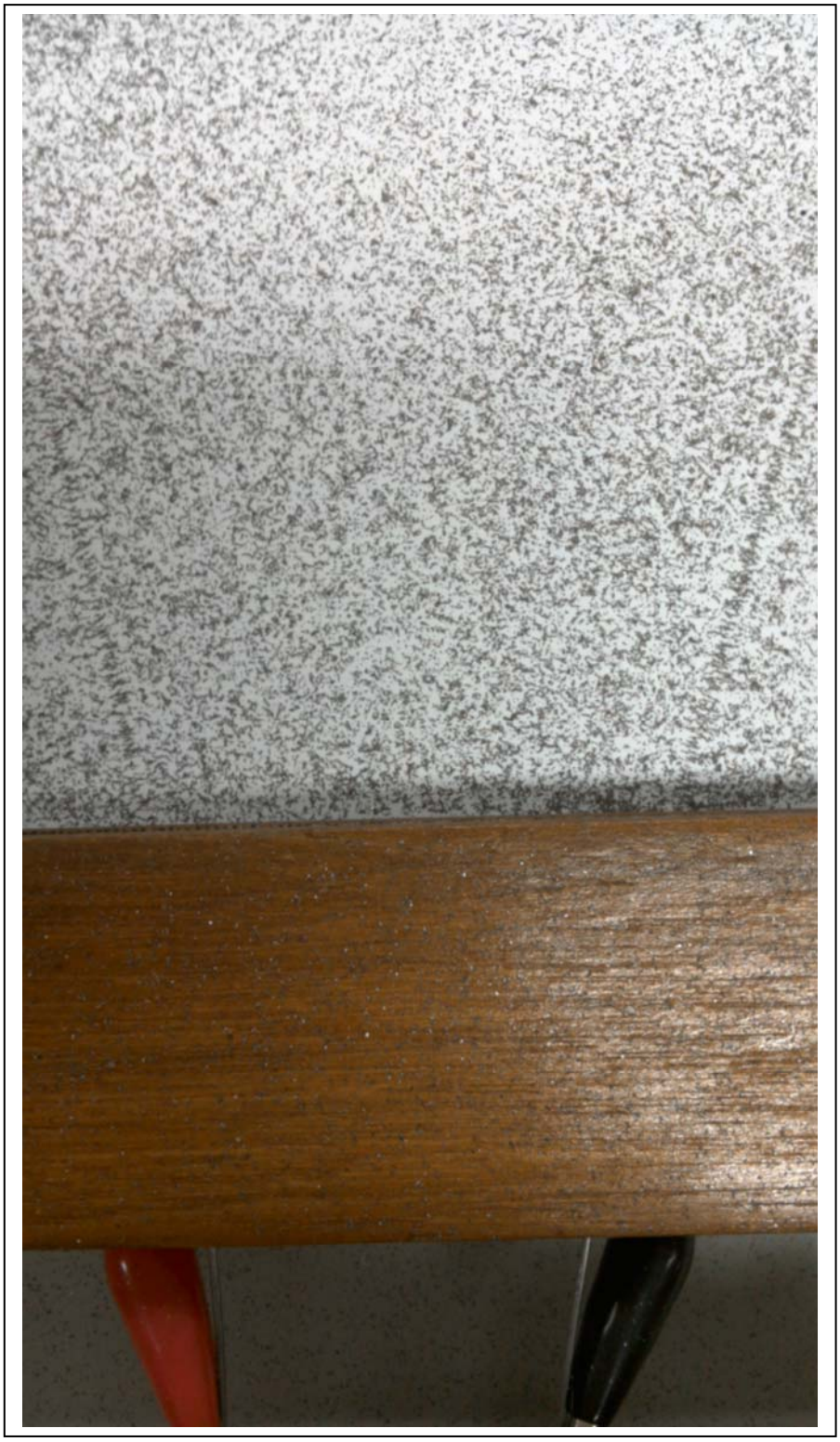
The setup is shown below:



The magnetic field lines were studied close to the terminals of the power supply since the greatest potential difference along the wire is at these points.

The magnetic field lines were made visible with the help of iron filings sprinkled on a sheet of paper placed over the wire, and spread as uniformly as possible along the wire.

Below is the result of one of the runs.
At the bottom of the figure are the terminals: the positive terminal (red) is at the left and the negative terminal (black) is at the right.
Observe the slight difference in the crowding of the magnetic field lines at the side of the wire connected at the negative terminal.



Below is the result of another run, with two close ups. The same effect of crowding of lines near the negative terminal is visible (the negative terminal is at the left).

In another experiment, very few iron filings were used.
The figures show the initial distribution of the iron filings (left figure) and the field lines they formed when the current was passed and the paper was tapped lightly (right figure).

The negative terminal is at the left and the positive terminal is at the right.
It is still observable a slight crowding of the magnetic field lines near the negative terminal compared to the lines at the positive terminal.

It becomes apparent that with a more powerful power supply these effects will become more visible. A more powerful power supply would be capable of delivering greater currents -increasing the visibility of the magnetic field lines- at a greater potential difference -increasing the difference in the density of magnetic field lines near the terminals.

Summary
This work reports on an effect observed by the author that consists in a difference in the density of the magnetic lines of force at different points along a current carrying wire.
The difference in the density of magnetic field lines is attributed by the author to the potential difference of the points where the magnetic field lines are observed and is believed to support a theory developed by the author related to the nature of the electric current, of electricity and of the electron, as well as the conduction and superconduction of electricity by wires, which will be published in the near future.