# Implications of Infinite Current Densities at Idealized DC Generator Poles

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## 1. Abstract.

A mathematical proof has been made elsewhere predicting the appearance of infinite current densities in the vicinity of idealized DC generator poles with a vanishing linear extension. The discovery was made, as a complete DC circuit was being analyzed mathematically as a part of the analysis of experimental results with Ampére's bridge in the 1980s. The author has proposed that the research upon among others cold fusion would benefit from the discovery, as very high energy densities will be needed in order to achieve fusion, and this will happen in an electric circuit, too, provided the current density is high enough.

Since no reactions have been observed thus far with respect to the publication of the discovery, it seems necessary to emphasize this discovery again through a special paper, focusing solely upon the analysis of a DC source.

More generally, the discovery will be of great use within all calculations of electromagnetic forces involving a DC generator, or a discharging capacitor, as well.

## 1. Why should there exist infinite current densities anywhere in a closed DC circuit?

At first glance, it is difficult to realize why there should exist a place within a closed DC circuit, where the current density could approach infinity The traditional approach is that a DC current flows at a constant value throughout the circuit.
In the paper [1] Jonson however shows that by means of mathematical necessity there must appear infinite current densities at the DC generator poles [2]
The reason is to be found among the principles of mechanics, namely that there can not be done any net work within a closed system; in this case it must be meant electric work. If e.g. a DC current circuit is to be regarded as a closed system, the switching on of the current will not lead to any net electric work, only that the charges are redistributed.
The electric field between the poles does a work upon the electrons, as they are flowing from the minus pole to the plus one.
That work, hence must be counterbalanced by a work done at the rest of the charges, i.e. upon those still remaining at the poles. And, if the poles are to be regarded as 'idealized', i.e. infinitesimally thin, as well as unmovable, that in turn implies that the current density must be infinite, if any work were to be done.

### 1.1. A detailed analysis.

The analysis in the above mentioned paper [1] proceeds through drawing the consequences of the charge loss, as the electrons are moving from plus to minus.
For every charge thus released, namely, the force the shortest way between the poles, i.e. through the battery, will decrease, hence allowing for a small displacement of the electrons that are still remaining at the plus pole. They attract the positive ions at the minus pole. If the poles are regarded as idealized, i.e. being infinitely thin, mathematics nonetheless allows for defining a corresponding infinitesimally small displacement, say $\Delta s$ . And as the electrons move that distance, they will be affected by a corresponding potential loss $V'=\frac{\Delta s}{L}V$

If the current through the connecting will give rise to the electrical effect $P = V \bullet I$ , due to the above mentioned requirement that no net work can be performed within a closed system, the electrons being displaced at the plus pole inevitably must do the same work, but in the opposite direction.

Hence, $I'=-\frac{L}{\Delta s}I$

Such an expression does not make sense if not first finding an adequate mathematical formalism that expresses what is intended by the formula, namely that the current is infinite within the starting and the end points at the plus pole. That fact is best expressed by using the Heaviside function.

Accordingly, $I'=-\frac{L}{\Delta s}I(H(s-L)-H(s-L+\Delta s))$

Letting $\Delta s$ approach zero gives: $\lim_{\Delta s\to 0} I'(s) = -IL\delta(s-L)$

Hence, it has been predicted that by mathematical necessity, that there must exist an infinitely strong current at the plus pole.
It may of course be argued that also the positive ions at the minus pole must be symmetry reasons have a corresponding current. That means that the both poles would **have half** the recently derived current.

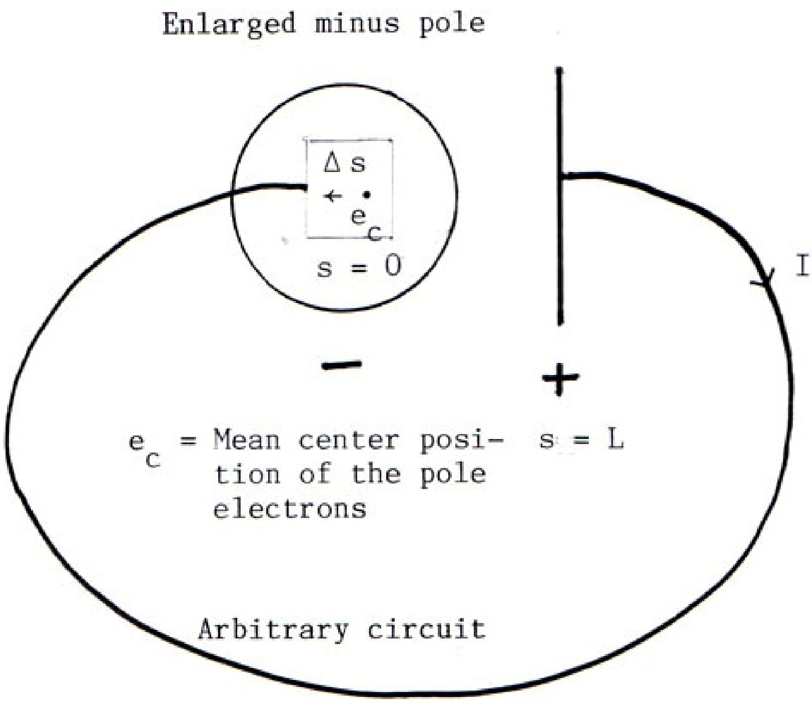


**Figure. Model of a closed DC circuit.**

**2. Consequences of the existence of infinite currents**

If the current is infinite but the spatial extension restricted it means also that the current density is infinite, since by differentiating a dirac function, another dirac type function is resulting. Having thus both an infinite current and current density, it must mean that the energy density is also infinite at that very thin region. If pushing molecules into the vicinity of the poles, suitable for thermonuclear fusion, that would become an option. A prerequisite must be that the poles are well constructed, allowing for a 'meeting' between the infinite current and the participants in thermonuclear fusion. Maybe this requirement is difficult to fulfil, thereby causing easily failures, when performing experiments.

**3. References**

[1] Jonson, J. O., 'The Magnetic Force between Two Currents Explained Using Only Coulomb´s Law', Chinese Journal of Physics, VOL. 35, NO. 2, APRIL 1997, pp. 139-49, http://psroc.phys.ntu.edu.tw/cjp

[2] ibid. p. 144f