In Disdain of Garbage Physics

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Abstract

Superficial evidence circulating on the World Wide Web appears to indicate that a device called the Motionless Electromagnetic Generator (MEG) is capable of outputting more energy than what is provided to it. This evidence is present in the form of a United States Patent awarded to the inventors of the MEG in addition to collaborative experimental measurements that appear to verify that the MEG is able to perform as claimed.

It is the purpose of this paper to take you, the reader, on a personally rewarding journey in the use of the scientific method. While this paper is written with the scientific method as its basis, you will not have to be a scientist to read and understand it. I invite you to follow along in the pages that follow to see how the application of *basic* scientific principles can be used to expose a fraud.

1 Introduction

This paper is my response to "scientific" claims being made on certain websites around the Internet regarding a device called the Motionless Electromagnetic Generator (MEG). On May 10, 2002 an item appeared in the weekly commentary of James Randi's website [1], that brought awareness of this device to this author for the first time.

Those who have designed this device, and others who have made measurements of its output power, make the extraordinary claim that the MEG device outputs more power than what is supplied to it by an external power supply. Power is the **time rate of energy transfer**. These people claim that the extra power comes from the Quantum Vacuum; a "sea" of "infinite energy" just waiting to be tapped. If it can be shown, however, that the device performs as expected from the standard laws of physics, then the claims of these people become tantamount to claiming that one has a perpetual motion machine of the first kind [†]; in direct violation of the physical Law of Conservation of Energy. Yet, the data for this claim exists for public viewing for all to see. What is more, the inventors of the

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[†]A perpetual motion machine of the second kind is one that is 100% efficient in its use of energy for output work. In fact, the patent of Bearden et al. claims the MEG can also be disconnected from its external power supply and made to run indefinitely on its own output power by feeding the output voltage back into the input coils. This makes the MEG a perpetual motion machine of **both** types!

MEG have obtained a patent for this device with the United States Patent and Trademark Office [2, 3].

If this claim were true, the consequences for humankind would be unimaginably profound. No longer would pollution be a scourge on our environment and our health; no longer would nations need go to war over limited resources; no longer would abject poverty exist for any man, woman, or child. Cars would no longer burn fossil fuels; reversal of the Global Warming threat would promptly ensue. Peace could reign; all people's could be free to live rewarding and fruitful lives. Humanity would finally achieve something of Sir Thomas More's *Utopia*.

In what follows I expose the fraud of the MEG and of those who purport it to be a "free energy" device using their own data with sound application of the scientific method. But first, some basic theory.

2 Some Basic Physics Theory

This section lays out the simple theory and equations needed to understand the MEG data. If you are not frightened by basic algebra, then you should have no problems whatever with what follows.

2.1 Equations for Debunking the MEG Data

Ohm's Law is well known from basic electric circuit theory [4, 5]. If one passes an electric current, I, through a resistor with resistance, R, then the voltage across the resistor is just,

$$V = IR\,. \tag{1}$$

This equation holds equally well for direct current (DC) and for alternating current (AC). It is also well known that the power output, P, from a resistor is just,

$$P = VI = \frac{V^2}{R} = I^2 R\,, \tag{2}$$

where the last two expressions have been obtained by substituting equation 1 into equation 2. Equation 2 holds in both DC and AC, however, it must be borne in mind that in AC this equation only tells you the "instantaneous" power output at the specific time you measure it at. The next paragraph explains why this is so.

Figure 1 shows you what a sine wave (for current) looks like, with all the essential features indicated. It has a maximum value (also called the amplitude), labelled I_0, and notice that one complete cycle of the wave occurs over a time period of T. I have also indicated with the red arrow what is commonly referred to as the peak-to-peak amplitude; which by the symmetry of the shape of the sine wave, is just the maximum amplitude, I_0, multiplied by two. You can clearly see that at different values of time the value of the current is different. As a result, $P = VI$ will also be continuously changing from moment to moment. This is why the equation $P = VI$ for AC currents and voltages gives you the "instantaneous" power at the specific moment in time that you measure it.
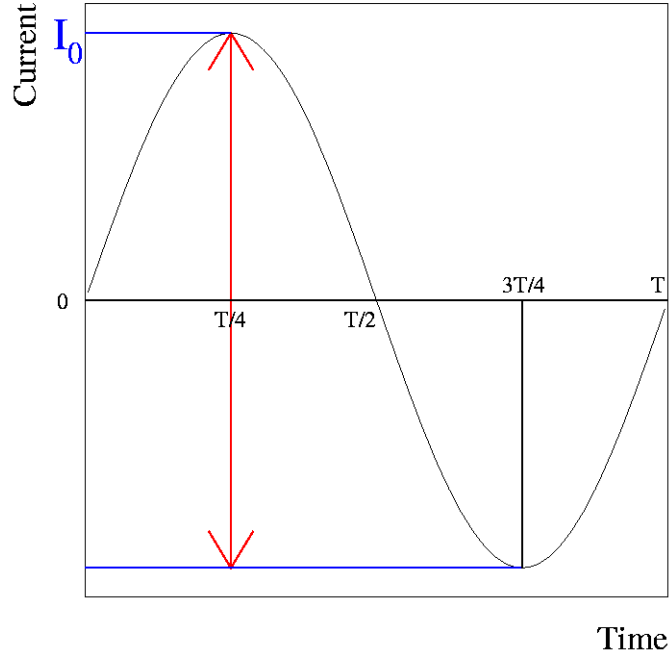
Figure 1: Sine wave current input shown over a duration of one period of its cycle. The essential features shown are the maximum current (amplitude) I_0 and the one-quarter intervals of the total period, T, of its cycle, and the peak-to-peak amplitude, as indicated by the red arrow.

For AC circuits, we need to know what the *average* power output is over one complete cycle of the current. If the voltage, V, is *constant* and the current is a sinusoidal AC, the average power over one cycle, P_{ave}, is given by,

$$P_{\text{ave}} = V \frac{I_0}{\sqrt{2}}. \tag{3}$$

Similarly, if the voltage is sinusoidal, its average value over a cycle is $V_0/\sqrt{2}$, and substitution of this into equation 2 gives us,

$$P_{\text{ave}} = \frac{V_0^2}{2R}, \tag{4}$$

where V_0 is the amplitude of the voltage sine wave (exactly analogous to I_0 in figure 1).

Last, but not least, if both the voltage and the current are sinusoids, then the average power over one cycle is given by,

$$P_{\text{ave}} = \left(\frac{V_0}{\sqrt{2}}\right)\left(\frac{I_0}{\sqrt{2}}\right) = \frac{V_0 I_0}{2} \tag{5}$$

The results of equations 3, 4 and 5, found in any standard first year physics text book [4], are all you need to arm yourself with to see that the claim being made by Bearden and Naudin of the MEG being a "free energy device" is nothing less than a mendacious fraud.

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3 The MEG: What is It?

The MEG is nothing more than an electrical power transformer of standard design and is, in this respect, completely unimaginative. As shown in figure 2, it consists of a closed loop of magnetic core material around which are mounted four coil wire windings. The two input coils are shown in orange: these coils are provided the *external* voltage and current by an external power supply. The two output coils are shown in olive: these coils provide the *output* voltage and current from the device.

An application of Faraday's Law of electromagnetic induction [4, 5] for a transformer will tell you that the output voltage, V_{out}, from any one of the two output coils is simply given by,

$$V_{out} = \frac{N_{out}}{N_{in}} V_{in} \; , \tag{6}$$

where N_{in} and N_{out} are the number of wire turns on the input and output coils, respectively, and V_{in} is the user supplied input voltage on one of the two input coils. This equation allows us to predict in advance what output voltage we should observe from the MEG given the input voltage. We shall apply this simple result later on.
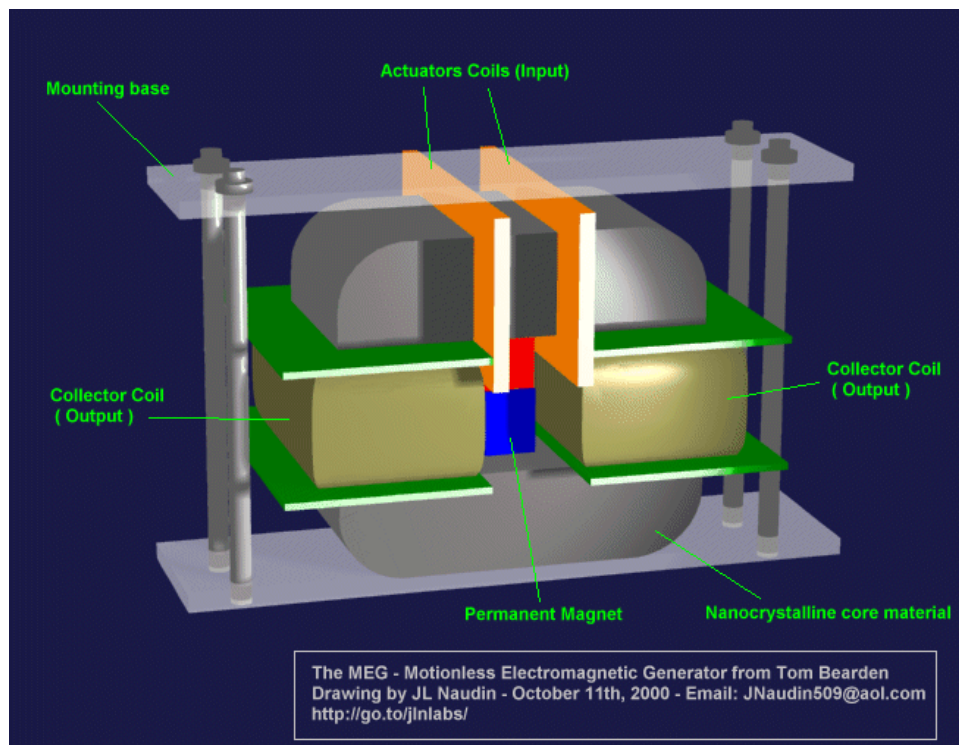

Figure 2: A 3-D representation of the MEG. The input coils ("actuators") are shown in orange, the output coils ("collectors") are shown in olive. The magnetic core material, which passes through each coil, is shown in grey. Note the presence of the "red herring" permanent magnet, shown in red/blue. Image taken from [6].

And that is about all there is to say about the MEG. I will conclude this section by adding that the permanent magnet inserted in the centre of the magnetic core serves absolutely no purpose whatsoever in the operation of the MEG; its only purpose is to obfuscate the explanation of the operational principles of the MEG in the patent. Interested readers should consult Faraday's Law to learn why its presence is irrelevant. Suffice to say, only *time varying* magnetic fields will induce a voltage in a coil: the magnetic field produced by a permanent magnet is *constant and unchanging in time*, and therefore, does nothing for electromagnetic induction in the output coils.

4   The MEG Data

Naudin [7, 8] has performed measurements comparing the input power to the output power of the MEG, and claims that he observes more power out of the device than what he puts in, as predicted in a patent by Bearden [2] et al. Naudin's data "demonstrating" this claim, freely available for all to see and use, can be found on his website [7] and are shown here in figure 3. As is clearly visible in the data plot of figure 3, it does appear that the MEG is outputting more power than what it receives through its input coils! Could the claims be
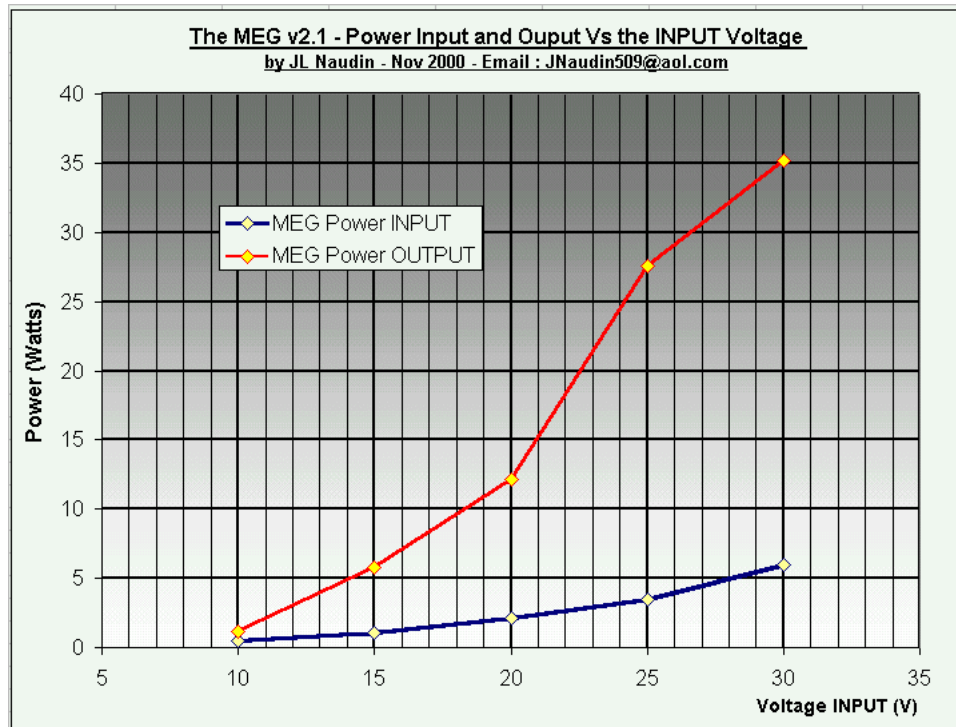

Figure 3: The MEG input and output power plotted as functions of input voltage. The plot indicates that the output power (red curve) is greater than the input power (blue curve), in contradiction with the Law of Conservation of Energy.

true?!

As I am a scientist who firmly accepts the centuries of experimental results that verify time and time again the validity of the Law of Conservation of Energy, looking at this data I had to ask myself the following question: "If this data is not fabricated, what is wrong with the experimental method and/or Naudin's interpretation of his data to produce this false result?"

The answer to that question follows in the next sections where you will learn that Naudin's data is misinterpreted and that, in fact, the MEG is putting out the **same** amount of power as what it receives.

5   Looking Closely at the Data

The data and figures of this section have been taken directly from Naudin's website [7]. At his site we find the following quote by Naudin in reference to his MEG data:

> a "conditionned" (sic) R_{Load} (100 Kohms, non inductive carbon, 5Watts) or a MOV (Metal Oxide Varistor) is REQUIRED for getting the output datas (sic) measured above.

The data which follows only concerns a test Naudin performed with his MEG V3.0 device, as shown in figure 4, where we see each output coil of the MEG V3.0 attached to an identical resistor. By his own quote, we must assume that these resistors must each be 100 kΩ.

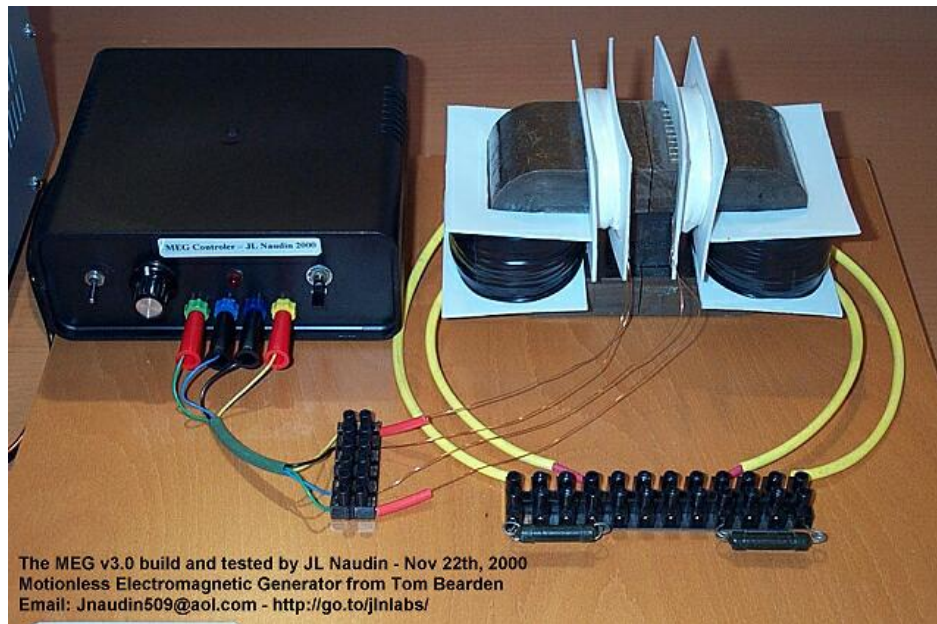Figure 4: The experimental set-up of Naudin's MEG V3.0, showing both output coils attached, by way of the yellow wires, to identical 100 kΩ resistors.

Figure 5 shows the voltage and current inputs/outputs of the MEG. Now, let us go through this with care because it is here where we discover the fallacy in Naudin's data interpretation. The top panel of figure 5 shows the input voltage, in blue, and input current, in yellow, going into one of the input coils of the MEG (ignore the red curves). Using the legend in the panel we see that the time scale per division on the oscilloscope trace is 10 microseconds, the voltage scale per division is 10 volts, and the current scale per division is 100 milliamperes. With these we can deduce the following from this data:

- The input voltage is constant and is about 28 V.

- The input current is AC (not perfectly sinusoidal, but close enough).

- The amplitude of the AC current, I_0, is about 125×10^{-3} A (take the difference in the peak-to-peak values and divide by two).

The bottom panel of figure 5 shows the output voltage, in blue, and output current, in yellow, coming out of only *one* output coil of the MEG. Reading the data legend of this panel we can deduce that:

- The output voltage is sinusoidal and has an amplitude of roughly 500 V (take the difference in the peak-to-peak values and divide by two).

- The output current is sinusoidal and has an amplitude of 44×10^{-3} A.

With these experimental facts we are now ready to see that, with the theory of section 2, the MEG performs exactly in accordance with the known laws of physics and is most certainly *not* a free energy device!

6 Comparing Power In to Power Out

Let us use equation 3 and Naudin's data to determine what his input power is. Putting in the numbers from the input voltage and current, we get as power into the MEG,

$$P_{\text{in}} = \frac{28 \times 0.125}{\sqrt{2}} = 2.47 \, \text{watts}.$$

Now, as quoted in § 5, the voltage curve in Naudin's output data was obtained by measuring the voltage across a 100 kΩ resistor in series with one of the output coils, as previously shown in figure 4. With this information we can use equation 4 to determine the MEG output power. Putting in the output voltage amplitude of 500 V, and knowing it was measured across the 100 kΩ resistor, we get for the output power,

$$P_{\text{out}} = \frac{500^2}{2 \times 100000} = 1.25 \, \text{watts}.$$

This is the power out of only **one** of the two MEG output coils. As each output coil is loaded in the same way (figure 4), we merely have to double this result to get the total power out, which is 2.5 watts, in complete agreement with the power going in!
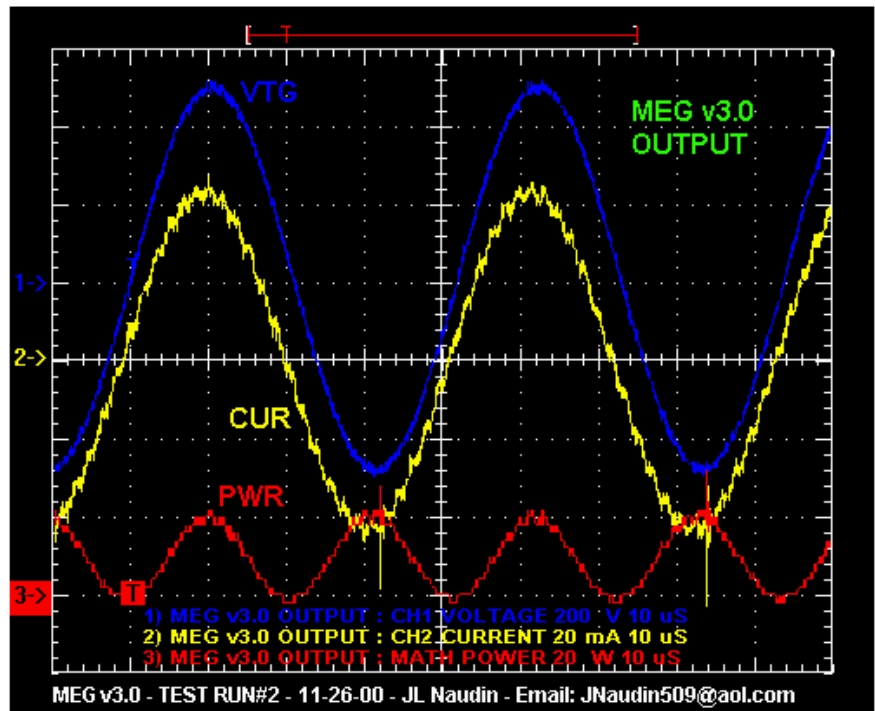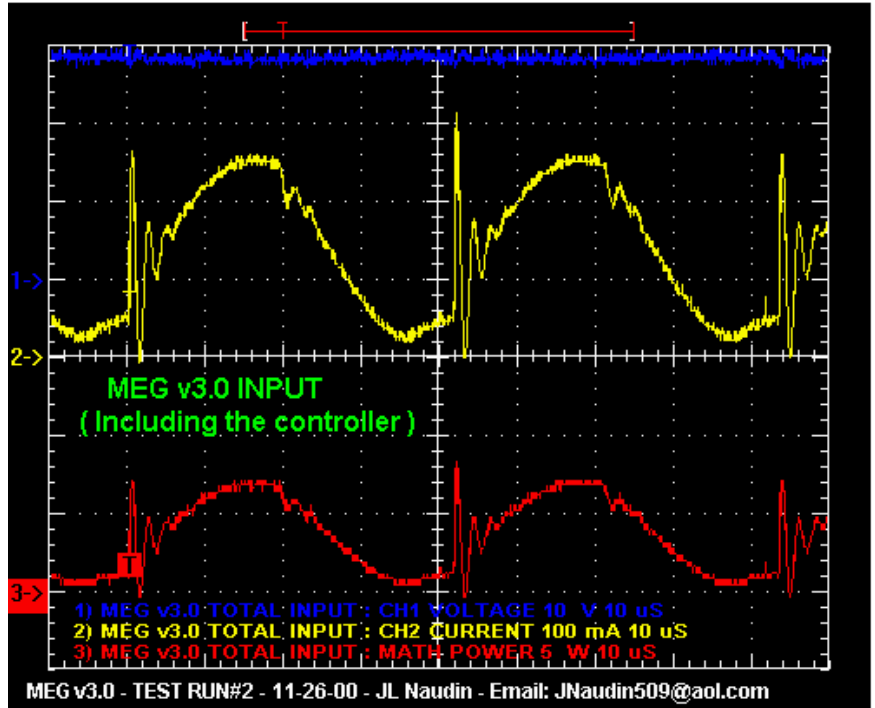
Figure 5: The input and output signals from the MEG. The top panel shows Naudin's input voltage (blue trace) and input current (yellow). The bottom panel shows the MEG output voltage (blue trace) and output current (yellow trace).

From § 5, we also see that the output voltage is about 17 times that of the input voltage. This is hardly surprising when we consider equation 6 and read off the number of turns in the input and output coils as shown in figure 6 ‡. The number of turns in the input coil is 100 and the number of turns in the output coil is 1500. The ratio between output and input turns is 15 which is close enough to 17 given the imprecision of reading Naudin's data plots using just the eye §. On all accounts, the device is obeying the well known laws of physics and is doing nothing spectacular whatsoever!
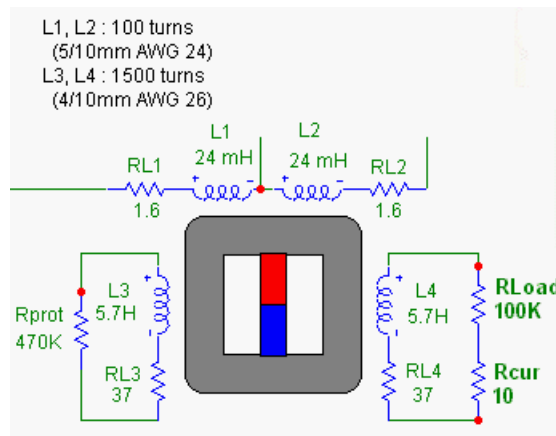

Figure 6: Naudin's circuit diagram for the MEG V3.1. The number of turns of the input and output coils are shown.

Before concluding this section, I would like to point out a serious error in the work of Naudin. Now, as mentioned, Naudin measured his 500 V output voltage across the 100 kΩ resistor. What does Ohm's Law tell us should be the current through that resistor? Let us use equation 1 after rearranging for the current, I:

$$I = \frac{V}{R} = \frac{500}{100000} = 5 \times 10^{-3} \, \text{amperes},$$

or $I_0 = 5$ milliamperes amplitude. We can check if this result is right by seeing what the output average power should be using equation 5. Putting in the values we get:

$$P_{\text{ave}} = \frac{500 \times 0.005}{2} = 1.25 \, \text{watts}.$$

Again, doubling this for the fact that there are two output coils, and once again, we have complete agreement with the input power. I point this detail out to show that Naudin's

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‡This diagram is from the MEG V3.1, which explains why the load resistor on the left output coil is not 100 kΩ as in figure 4. Other photos on Naudin's site show that the physical construction of the MEG V3.1 core and coils are the same as that for the MEG V3.0.

§The difference between expectation and my estimate can be reconciled with a 2 V error on the input voltage and a 30 V error on the output voltage. Not difficult to imagine, considering a "tick mark" for the input scale is 2 volts and a "tick mark" on the output scale is 40 V; and each voltage trace line is about one "tick mark" thick (see figure 5).

measurement of output current is internally inconsistent with the rest of his data – his output current measurement of 44×10^{-3} amperes is wrong by a factor of nine.

7 Conclusion

On the basis of Naudin's own data the MEG is not a "free energy" device or a perpetual motion machine: It puts out, to within the uncertainty at which I'm able to estimate the data, the same amount of power as what is put into it. As if we should expect anything different from this! We also see that the device performs in accordance with a well known law of physics: Faraday's Law; again, as if we should expect anything different. Finally, the work of Naudin is filled with errors and misinterpretation.

Yet, despite all of this, we see in a journal paper [9] the following quote in reference to replication of the MEG results:

> The device has been independently replicated by Naudin and is therefore reproducible and repeatable, meeting the requirements of scientific rigor.

This, as you can now see, is a wholly false statement. The device has failed on all accounts to meet the requirements of scientific rigor when inspection of Naudin's own data reveals it to be nothing more than a standard electrical transformer.

The only perpetual motion machine in all of this that I can see, is the perpetual cycling of the same centuries old garbage physics ideas from one scam artist to the next. Whether Naudin has wilfully befuddled his data to give the MEG the appearance of producing more power out than what is put into it, I cannot say for certain. What I can say for certain is that his overall scientific technique and ability is at a level of ineptitude that one only expects to find from someone who is wholly ignorant of what it is they are doing, or from someone who is wilfully deceiving their audience. I will leave it for you, the reader, to decide for yourself which of the two it is.

8 Acknowledgements

References

[1] James Randi, *The James Randi Education Foundation*, http://www.randi.org/.

[2] Thomas E. Bearden et al., *Patent No. 6,362,718*, United States Patent and Trademark Office, http://www.uspto.gov/.

[3] Thomas E. Bearden et al., more readily readable online version of patent, http://www.rexresearch.com/meg/meg.htm#usp

[4] Raymond A. Serway, *Physics for Scientists and Engineers*, Saunders College Publishing, 1990.

[5] David J. Griffiths, *Introduction to Electrodynamics*, Prentice Hall, 1989.

[6] Jean-Louis Naudin,*JNL Labs: The MEG Project*, http://jnaudin.free.fr/html/megdiag.htm.

[7] Jean-Louis Naudin, *JNL Labs: The MEG Project*, http://jnaudin.free.fr/html/megv21.htm.

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[9] P. K. Anastasovski, T. E. Bearden et al., Explanation of the Motionless Electromagnetic Generator with O(3) Electrodynamics, *Foundations of Physics Letters*, 87, Vol. 14, (2001)