

Electromagnetic Thrust Force of Unclosed Foucault Currents

S. A. GERASIMOV

Department of General Physics, Southern Federal University, Rostov-on-Don, Russia

Abstract: The weight of a closed system consisting of a source of an alternating magnetic field and a conductor depends on the position of the conductor in the magnetic field. By studying the influence of the environment on a conductor with unclosed Foucault currents, it is possible to measure the lift force created by such an electromagnetic thruster. The maximum weight changes are observed in regions where the magnetic field is the most inhomogeneous.

Key Word: Lift Force, Self-force, Alternative Magnetic Field, Average Unclosed Foucault Currents

Date of Submission: 05-06-2023

Date of Acceptance: 15-06-2023

I. Introduction

The induction current created by a variable source of a magnetic field may not be closed. Otherwise, alternating current could not flow through the capacitor connected to the winding of the alternator. The continuity of the total current in the circuit is ensured by the displacement currents flowing between the capacitor electrodes. On the other hand, the openness of the conduction current leads to the appearance of a self-action force with which an unclosed conductor acts on itself. This phenomenon has been experimentally discovered [1] and satisfies the momentum conservation law [2]. The total force with which a closed system with conduction currents and displacement currents acts on itself is strictly equal to zero. This phenomenon is due to the transverse nature of magnetic forces in classical electrodynamics. Thus, the force \mathbf{F}_{23} with which section 2 of a \square -shaped conductor C with current I acts on section 3 is not equal in magnitude and is not collinear with the force \mathbf{F}_{32} with which section 3 acts on part 2 (Fig. 1). The same applies to forces \mathbf{F}_{12} and \mathbf{F}_{21} . In this case, the forces \mathbf{F}_{21} and \mathbf{F}_{23} are equal in magnitude and opposite in direction, so their sum is zero. Forces \mathbf{F}_{13} and \mathbf{F}_{31} describe the interaction between parallel currents, their sum is also equal to zero. Therefore, the total force $\mathbf{F}=\mathbf{F}_{12}+\mathbf{F}_{32}$ acts on the \square -shaped conductor, with which this conductor acts on itself. This is the self-force.

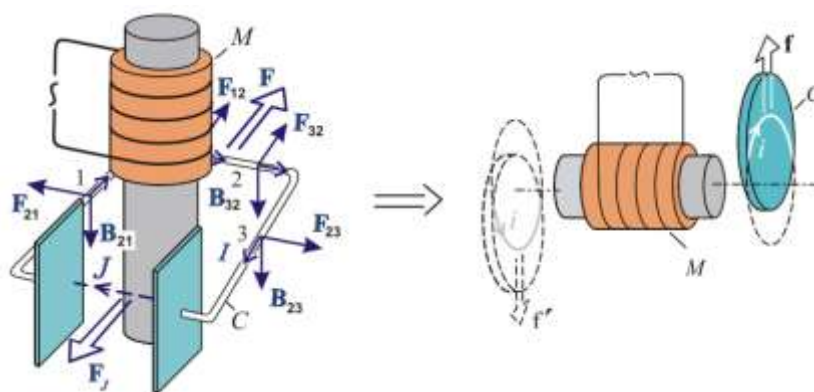


Fig. 1. Unclosed induction current and self-action.

Each magnetic force \mathbf{F}_{ij} is proportional to the strength of the current I and the induction of the magnetic field \mathbf{B}_{ij} . In turn, the induction of the magnetic field is proportional to the force in the circuit. Therefore, the self-force is proportional to the square of the current. The current strength of the inductive conduction current is proportional to the magnetic field induction created by a magnetic field source M external to the conductor. For this reason, the self-force is proportional to the square of the current flowing through the source of the magnetic field. The average for the period of change in the current supplying the system is not equal to zero [3]. Of course, the induction current also acts on the source of the magnetic field, creating another self-acting force [4], but its average value is zero.

In this interpretation, the electromagnetic thrust force acting on the system is extremely small. However, the Foucault currents flowing in a massive conductor are very large [5]. In this case, the squared forces of the Foucault currents of density \mathbf{i} also turn out to be very large values, creating significant self-forces with a density of \mathbf{f} . However, in order for the total thrust force to be non-zero, that is, for the Foucault currents to become unclosed, a magnetic field in which the conductor is located, should not be homogeneous. A symmetrical conductor, for example in the form of a thick disk, must be pushed into the region of maximum inhomogeneity of the magnetic field, for example upwards, creating a lifting force (Fig. 1). If the conductor, on the other hand, is below the horizontal, the lifting force is negative. All that is said above suggests what kind of experiment should be carried out in order to discover the electromagnetic force that allows solving the problem of electro-anti-gravity [6].

II. Experimental

The problem lies in measuring changes in the weight of a heavy electromagnetic propulsion device, consisting of an electromagnet M and a copper conductor C with a diameter 8 mm and with a thickness 4 mm, into which the electric current is supplied through conductors with rigidity. The electromagnetic thrust is mounted on a swinging platform Q , balanced with a load L (Fig. 2). Measurements should be carried out at different positions of the conductor relative to the magnetic field source. The quantitative characteristic of the position is the value c , counted from the upper base of the electromagnet. Measurements should be carried out periodically. This makes it possible not only to increase the accuracy of measurements, but also to take into account the drift of experimental results due to the heating of the conductor and the interaction of the entire measured system with the environment. Simultaneously with the measurements of the weight P registered by the scales S , the current strength U/R in the circuit should be measured. After each change in the position of the conductor, all experimental results should be divided by the values of the squares of the current divided by the square of the current at the beginning of the measurements. This makes it possible to take into account the change in the stiffness of the conductors during a mechanical or automatic change in the value of c .

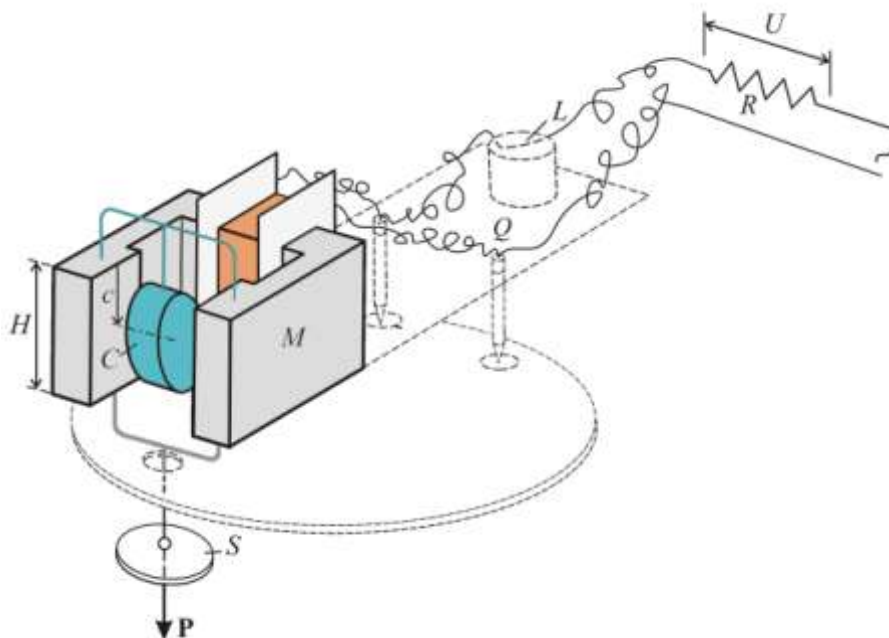


Fig 2. Electromagnetic thruster $M+C$ on balanced platform Q .

An example of such measurements is shown in Fig. 3. When an alternating magnetic field is turned on, the weight of the system δP actually decreases, but this is due not only to the appearance of an electromagnetic traction force, but also to thermal processes responsible for the interaction of a conductor with Foucault currents with the environment. This background component T from the experimental data W must be eliminated. Of interest is the positive part of the value $\Delta W=W-T$.

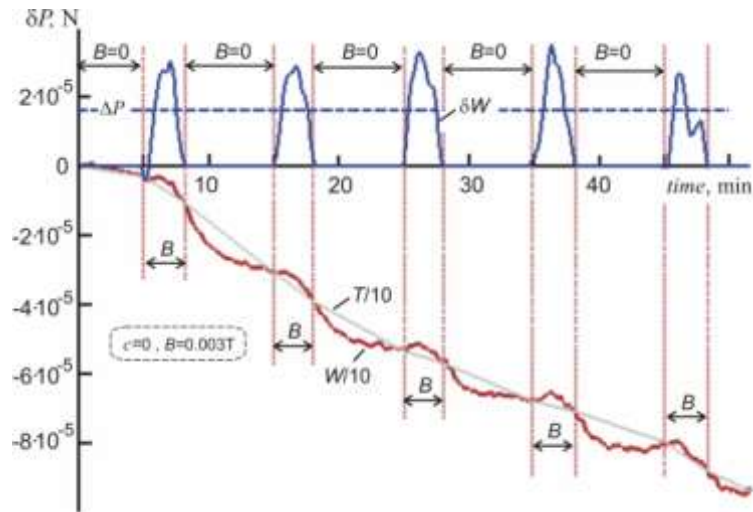


Fig. 3. Change in the weight of the thruster with periodic switching on of the magnetic field.

At first glance, it may seem that this contradicts the idea of the work. The change in weight ΔW for any value of c is always positive. The fact is that the electromagnetic effect of the environment, including laboratory equipment, on a conductor with Foucault currents has not yet been taken into account. This can be done only after a detailed analysis of the dependence of the average change in weight ΔP on the position of the conductor inside the magnet.

Quantitatively, the lifting force was found. The maximum weight loss was about $F \approx 1.2 \cdot 10^{-5}$ N with an effective value of the magnetic field induction in the center of the magnet cavity of 0.00044 T and an alternating current frequency of 50 Hz (Fig. 4). This is several orders of magnitude greater than the results of measurements of the hidden force with which an electromagnetic system with an alternating magnetic field is repelled by displacement currents [7].

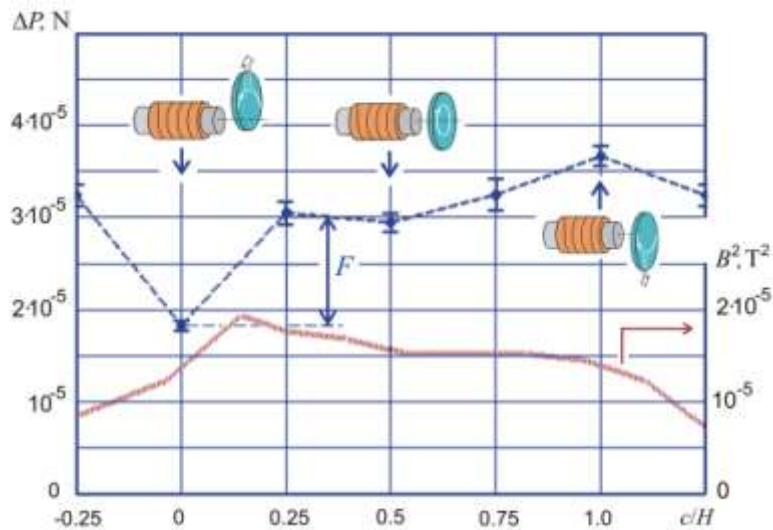


Fig. 4. Dependence of the change in the weight ΔP and square of the induction of the magnetic field B^2 on the position.

Questions have arisen, without answering which this result may seem doubtful. For $c=H/2$ there is no preferred direction, so the value of ΔP at $c=H/2$ can be considered as zero thrust force. With negative values of c , the magnetic field induction is small, so the value of ΔP at $c=-1/4$ is also close to zero. The same thing happens for $c=5H/4$. That is why Fig. 4 shows not only the experimental dependence of ΔP on c , but also the dependence of the square of the magnetic induction B on the position inside the magnet cavity. Most importantly, the significant weight loss at $c=0$ and the significant weight gain at $c=H$ fully support the expected

effect (Fig. 1). At $c=0$, the magnetic field is more inhomogeneous than at $c=H$, so the change in weight at the top location of the conductor is significantly greater than at the bottom one.

III. Conclusion

The traction force of the electromagnetic thruster was experimentally observed. In fact, this is a confirmation of the results of other measurements of the lift force [8], in which it was not the lift force that was measured, but the force with which the alternative source of the magnetic field acts on the conductor. Since the self-force is proportional to the square of the Foucault current, this is one and the same, although the previous experimental results cannot be called absolutely adequate for the task at hand.

As long as the force is low. However, since the induction current is proportional to the frequency, by increasing the frequency and the effective value of the magnetic field induction by a factor of 10, it is possible to achieve a 10^4 -fold increase in the traction force.

References

- [1]. Cavalleri G., Bettoni G., Tonni E., Spavieri G. Experimental Proof of Standard Electrodynamics of Measuring the Self-Force on a Part of Current Loops. *Physical Review E*. 1998; 58(2); 2505-2517.
- [2]. Gerasimov SA. Interaction of Current Elements, Conservation of Momentum and Pseudo-Self-Action in Magnetostatics. *Applied Physics and Mathematics*. 2014; (3): 3-6.
- [3]. Gerasimov SA. Aerospace Electromagnetic Thruster with Average Foucault Currents. *Advances in Aerospace Science and Technology*. 2022; (7): 25-33
- [4]. Gerasimov SA. Self-interaction and Vector Potential in Magnetostatics. *Physica Scripta*. 1997; 56(5): 462-464.
- [5]. Wangsness R.K. *Electromagnetic Fields*, New York: John Wiley. 1986.
- [6]. Valone T. *Electrogravitics systems*, Washington: Integrity Research Institute. 2005.
- [7]. Graham G.M., Lahoz D.G. Observation of Static Electromagnetic Angular Momentum in Vacuo. *Nature*. 1980; 285(5761): 154-155.
- [8]. Gerasimov SA. Foucault Currents in an Unclosed Conductor and Abraham Force. *Engineering Physics*. 2021; (10): 37-40.