ELECTROMAGNETIC SELF-ACTION

S.A. Gerasimov, A.V. Volos, Russia

Physics Department, Rostov-on-Don State University,
Zorge St. 5, 344090, Rostov-on-Don, Russia

The torque of a self-action exerting on the mobile part of the reactionless engine is measured. It is shown that there exists a value of the height of the mobile electrode at which the torque of self-action is maximal.

There is an opinion that a body can not act on itself [1]. The existence of the so-called force of self-action is believed to contradict to the law of conservation of momentum. This is nothing but prejudice. Though the experimental confirmations of existence of self-action [2-4], conventional science is ready to refuse modern electrodynamics and make up a new theory of electromagnetism [1, 5] in order to save Newton's third law in use. It is comprehensible. First of all, these are the theoretical [5] and experimental [3] errors. The equivalence [5] of the Biot-Savart force is mathematically coarse since in this case the highest terms of expansion of force of self-action are cast out. This equivalence violates law of action and reaction and Ampere force law for which the principle of equality and collinearity of action and reaction forces is valid. Non-linearity of dependence of the torque of self-action on the current intensity [3] makes us doubt in the validity of these results. Moreover, typical values of force [2, 4] and torque [3, 6] are too small even if direct current in the circuit is significant. It is required to pass through the direct current of hundred amperes to produce the considerable displacement or turn of a body. As a result, small values of the effect caused ambiguity in the explanation of the phenomenon [1].

In fact, searching the reactionless propulsive devices we usually forget about the magnetic self-action which arises when a body consisting of a magnet and incomplete electric circuit can move violating law of action and reaction [7]. This violation is proved theoretically [8] but peculiarities of this motion are not well discussed. The principle of such a motion is shown in Fig. 1. This is the magnetic interaction between two current elements one of which is a part of a closed circular loop $\boldsymbol{L}$ and another is perpendicular to the first one. Since the force $d\mathbf{F}_{jm}$ acting on any current element of the loop $\boldsymbol{L}$ is perpendicular to the density of current $\mathbf{j}_m$ then the $\mathbf{Z}$-component of the torque $d\mathbf{N}_m=[\mathbf{r}_m \times d\mathbf{F}_{jm}]$ is equal to zero while torque which exerted on the second current element by the magnetic field of the loop, does not.

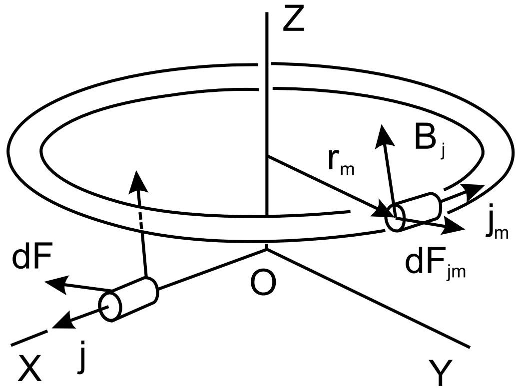

Fig. 1

Violation of law of action and reaction.
The force $d\mathbf{F}_{jm}$ with which the magnetic field $\mathbf{B}_j$ of another current element acts on the current of density $\mathbf{j}_m$, is not equal nor opposite to the force $d\mathbf{F}$ with which the magnetic field $\mathbf{B}$ of the first current element acts on the current of density $\mathbf{j}$.

An experimental device is shown in Fig. 2. A commercially available ring-shaped carbon-steel magnet $\boldsymbol{M}$ (inner radius – 20 mm; outer radius – 55 mm, height – 25 mm) of $2.2\mathrm{x}10^5$ A/m magnetization is located on the cover of a cylindrical electrode $\boldsymbol{E}$ suspended by thread $\boldsymbol{T}$. The electrode $\boldsymbol{E}$ is furnished with a central electrode $\boldsymbol{C}$ of the same height $\boldsymbol{h}$ and 5 mm diameter. The radius of the electrode $\boldsymbol{E}$ is 130 mm. The open end of electrode $\boldsymbol{E}$ and the central electrode $\boldsymbol{C}$ are submersed in a conducting liquid $\boldsymbol{L}_+$ and $\boldsymbol{L}_-$ placed in two volumes of a vessel $\boldsymbol{V}$ so that the depth of submergence of these parts is about 5 mm. In this experiment the conducting fluid is 10% solution of copper sulfate ($CuSO_4 5H_2O$). The vessel $\boldsymbol{V}$ consists of two thin coaxial plastic cylinders of 2 mm thickness. The radii of the plastic cylinders having the common bottom are equal to 10.5 cm and 18 cm. The height of the vessel is 12.5 cm. A disk and a ring-shaped electrodes $\boldsymbol{S}_+$ and $\boldsymbol{S}_-$ of 1.5 mm thickness are placed on the bottom of the vessel to supply the direct electric current of intensity I. All conducting parts of the device are made of copper. The thickness of the electrode $\boldsymbol{E}$ is 1.5 mm.

When the direct current *I* of density **j** flows through the electric circuit, the magnet and the electrode *E* rotate in the direction of the magnetic force *d***F** which is proportional to the vector product [**j**x**B**] as shown in Fig. 2. This is a force of self-action by means of which the mobile part of this device consisting of the magnet *M* and the electrode *E* acts on itself. However there is no force of reaction which could cause such a rotation. This is really true since a ring-shaped magnet is equivalent to two cylindrical surfaces with the surface current of density $\mathbf{j}_m$. The force of self-action *d***F** acting on the cover of the electrode is compensated by the force of self-action $d\mathbf{F}_*$ acting on the cylindrical part of the electrode *E*. Magnetic induction field $\mathbf{B}_*$ "does its part" as shown in Fig. 2. Therefore, it would be appropriate to find out how the height of the electrode *E* influences the value of the torque **N**. Such an influence is demonstrated in Fig. 3.

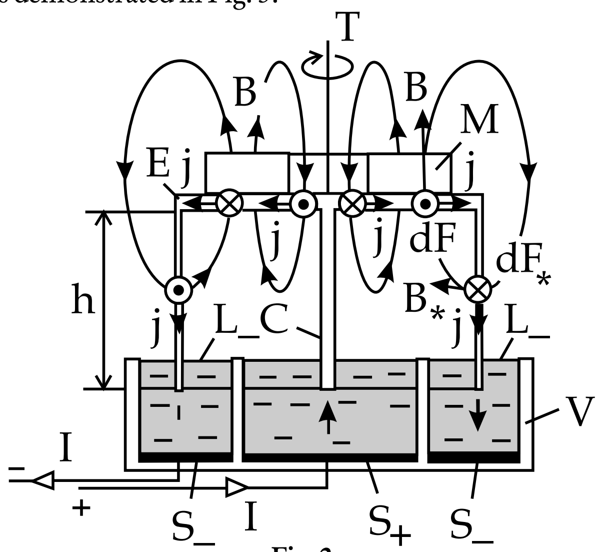

Fig. 2
Experimental device
(•) and (x) – directions of magnetic forces acting on various parts of the mobile electrode *E*

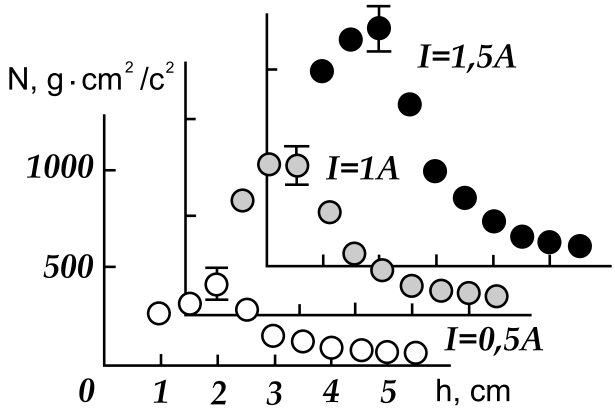

Fig. 3
Dependence of the torque *N* on the height of the electrode *h* at various values of the direct current *I* in the circuit

Thus there exists the value of the height *h* at which torque of self-action is maximal. This is the first result of the present work. At *I*=1 A and *h*=2 cm the electrode *E* turns at angle of 2.2 radian (126 °) with respect to the equilibrium position. Such a turn corresponds to 3.4×10^2 gxcm^2/s^{2}rad, i.e to the constant of torsion of the thread. The second result is that the maximum value of the torque of self-action *N* at the current *I*=1 A is even larger than the value of the torque produced by the traditional unipolar device [3] at the current 50 A.

In fact, this work represents an attempt to draw attention to a more effective and simple practical application of the self-action. It remains only to transfer electric current in an unclosed electrical conductor and such a possibility really exists.

References

1. Graneau N. The Finite Size of the Metallic Current Element. // Physics Letters A. 1990. V. 147. N. 2-3. P. 92-95.
2. Sigalov R.G., Shapovalova T.I., Karimov H.H., Samsonov N.I. Magnetic Fields and Their New Applications. // Moscow: Nauka. 1976.
3. Das Gupta A.K. Unipolar Machines. Association of the Magnetic Field with the Field-Producing Magnet. // American Journal of Physics. 1963. V. 31. N 6. P. 428-430.
4. Cavalleri G., Bettoni G., Tonni E., Spavieri G. Experimental Proof of Standard Electrodynamics by Measuring the Self-Force on a Part of a Current Loop. // Physical Review E. 1998. V. 58. N 2. P. 2505-2517.
5. Christodoulides C. Equivalence of the Ampere and Biot-Savart Force Law in Magnetostatics. // Journal of Physics A. 1987. V. 20. N 8. P. 2037-2042.
6. Serra-Valls A., Gago-Bousquet G. Conducting Spiral as an Acyclic or Unipolar Machine. // American Journal of Physics. 1970. V. 38. N 11. P. 1273-1276.
7. Gerasimov S.A., Volos A.V. On Motion of Magnet in Conducting Fluid. // Problems of Applied Physics. 2001. V. 7. P. 26-27.
8. Gerasimov S.A. Self-Interaction and Vector Potential in Magnetostatics. // Physica Scripta. 1997. V. 56. N 3-4. P. 462-464.