Lorentz force on open circuit

https://groups.google.com/forum/?hl=ru&fromgroups#!topic/sci.physics.foundations/KZ-5zN4hnlA

Peng Kuan considers two metallic spheres, which are connected together through an angled wire whose angle is 90°, in which circulates an alternate current. While the wire is not a closed loop, the capacitor made up by the two spheres is charged alternately, letting the alternate current circulate (Figure 1).

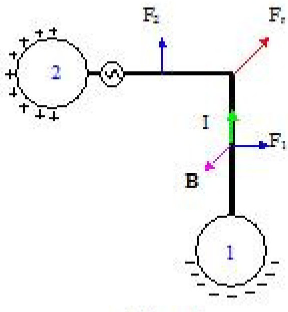


Figure 1

The current creates a magnetic field in space, which exerts a Lorentz force on the wire. The Lorentz force, $\mathbf{F_1}$ and $\mathbf{F_2}$, being perpendicular to the current, is in the x direction on arm 1 and the y direction on arm 2. The two arms are of equal length and the forces on them have the same magnitude F. So, the resultant force $\mathbf{F_r}$ is:

$$\mathbf{F}_r = \mathbf{F}_1 + \mathbf{F}_2 = F(\mathbf{e}_x + \mathbf{e}_y)$$

The directions of $\mathbf{F_1}$ and $\mathbf{F_2}$ do not change for alternate currents. The resultant force $\mathbf{F_r}$ is an internal force because the magnetic field is created by the wire itself, but $\mathbf{F_r}$ is nonzero.

Peng Kuan claims, there is no reaction force that opposes $\mathbf{F_r}$, and the Newton's third law is violated.

I think, author does not take into account that the alternate magnetic field infringes the symmetry of electric field between the metallic spheres because of $\mathrm{curl}\,\mathbf{E} = -\partial_t \mathbf{B}$. This infringement results in components of the attracting forces that (components) are opposed to $\mathbf{F_r}$ (Figure 2).

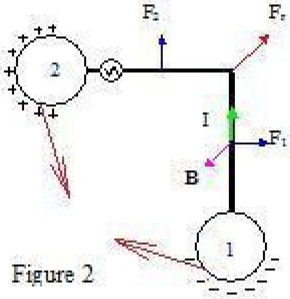


Figure 2

To clarify this idea, let us consider, instead of two spheres, a flat condenser, which is closed on the right side (Figure 3). For simplicity, we do not use a current source. Instead we excite a stationary wave in the system.

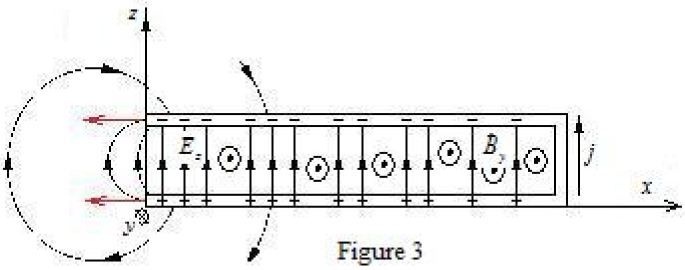


Figure 3

$$E_z = \cos x \cos t,\ B_y = -\sin x \sin t$$

satisfy the Maxwell equations

$$\mathrm{curl}\,\mathbf{E} = -\partial_t \mathbf{B},\ \text{i.e.}\ \partial_x E_z = \dot{B}_y,$$

$$\mathrm{curl}\,\mathbf{B} = \partial_t \mathbf{E},\ \text{i.e.}\ \partial_x B_y = \dot{E}_z;$$

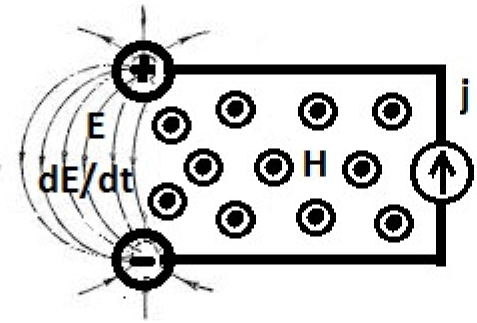
$$\text{and}\ \dot{B}_y = -\sin x \cos t,\ \ j = \sin t.$$

The fields, E_z, $\dot{B}_y$, in Figure 3 correspond to $t = 0$

It is seen that electric field pressure $E^2/2$ on the left side gives rize forces acting on the plates.

R. Khrapko 16.09.2012

I decided that the Ampère force acts on the displacement current dE/dt in the same way as the conduction current j. The alternating current in this "self-engine" does not matter. All reasoning is made easier at a constant current, which continuously charges the "capacitor". So, a constant magnetic field, trying to push the currents limiting it, acts to the right to the wire with current and to the left to the lines of force of the electric field, pushing them away.
As a result, Coulomb's force gets a component to the left, as I drew in 2012



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