Tangential force motor with regular magnets

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1. Tangential magnetic force in ordinary magnetic field

My experiment **Circular motor driven by tangential magnetic force (pdf)**, (**word**) showed tangential magnetic force making a circular coil rotate. Someone has objected that the particular field of the quadripole magnet was confusing. So, I made a motor with regular magnets to show that tangential force exists generally in all kind of magnetic field. See this video: http://youtu.be/qTyrjRSqOvU

Figure 1 shows the circular coil and Figure 2 shows a disc magnet making the coil rotate. The explanation of the experiment sequence by sequence follows.

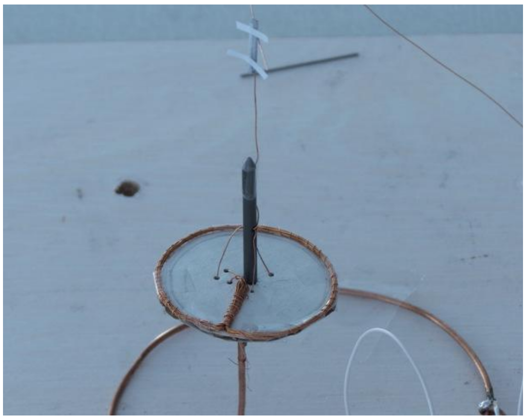

Figure 1

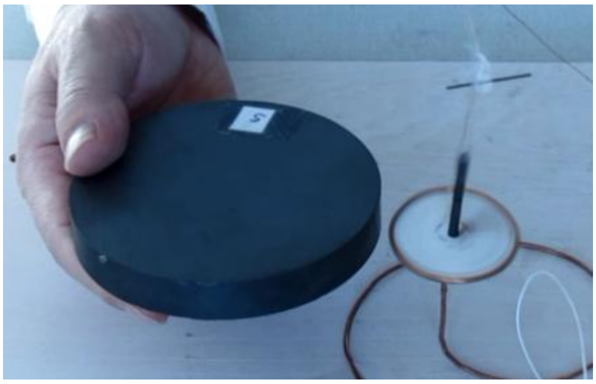

Figure 2

1. Disc magnet parallel to the coil

The coil's axis of rotation is along the z direction. The magnet is parallel to and beside the coil, which rotates rapidly showing that the force on the coil is tangential to the circular current. When the magnet is at a longer distance from the coil in the x or z direction, the coil stops showing that the magnet's field is responsible for the tangential force.

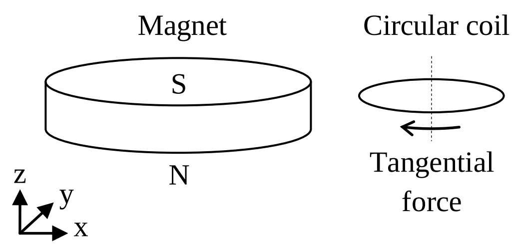

Figure 3

2. Disc magnet facing the coil

The field lines cross the coil in its plane and the coil rotates well. The rotation of the coil slows down gradually as the distance from the magnet increases, indicating that the tangential force from a facing magnet has a longer range.

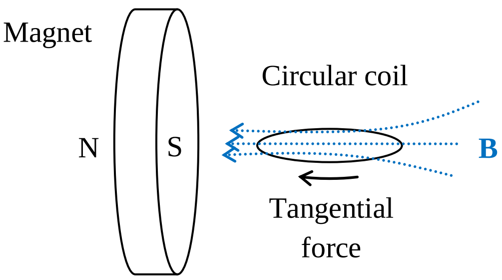

Figure 4

3. Disc magnet orthogonal to the coil

The N-S line of the magnet is along the y direction. The field lines are also in the plane of the coil, but the coil stops completely. No tangential force arises. With the precedent case, we have 2 cases where the field lines are in the plane of the coil, but the tangential forces are completely different. So, the vector approach of magnetic field is inappropriate for tangential force.

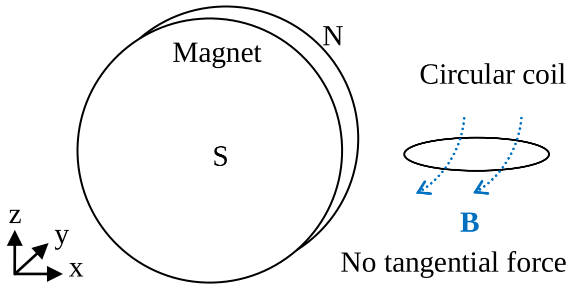

Figure 5

4. Rectangular magnet facing the coil

The N-S line of the magnet is vertical. The coil rotates rapidly whether the wide side or the narrow side is facing it.

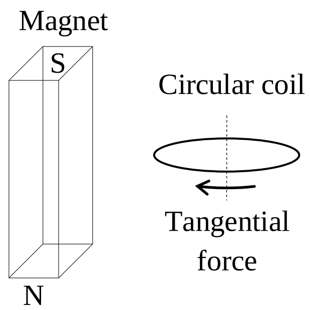

Figure 6

5. Rectangular magnet under the coil

The N-S line of the magnet is along the x direction. The coil rotates and jumps showing a perpendicular magnetic force that pushes the coil upward as well as a tangential force. The former is a Lorentz force.

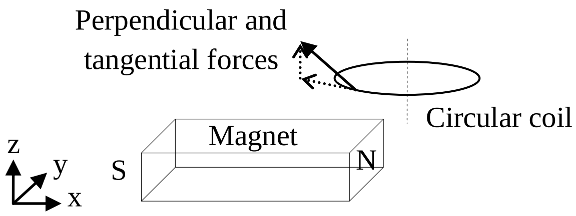

Figure 7

6. Rectangular magnet N-S line horizontal

The N-S line of the magnet turns from the z direction toward the y direction. The coil stops quickly. No tangential force arises when the N-S line is along the y direction.

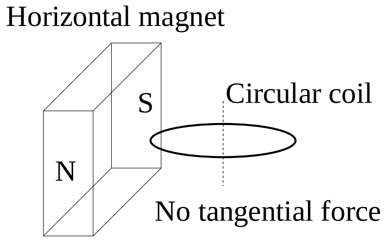

Figure 8

2. The U-turn wires

In this experiment, the coil is round but possesses a peculiar feature: the U-turn wires (see Figure 1 and Figure 10). As the magnetic effect of the forward current cancels that of the backward current, the U-turn wires do not create any Lorentz force. Then, why are they there?

In fact, the tangential force is very weak when the wires are only circular. I have figured out that because electrons move freely in conductor, they cannot act force parallel to their velocity on the solid structure of the conductor. The only force they can exert is centrifugal force, which is perpendicular to their trajectory. For example, the current I_0 in Figure 9 flows in circle and the force I_0 acts on the wire is perpendicular to the circular wires. So, in case where a tangential force is acted on electrons, it accelerates them without pushing tangentially the wire.

The only way to make the wire collect tangential force is to make the electrons turn an appropriate angle so that the centrifugal force possesses a component parallel to the wire's circle. I have noticed that when the poles of connection of the coil are near the magnet the tangential force is stronger. This is because the currents I_1 and I_4 change direction while entering and exiting the coil and transfer their tangential momentum to the wire (see Figure 9).

In my precedent experiment **Circular motor driven by tangential magnetic force (pdf)**, (**word)**. The quadripole magnet is designed to maximize the tangential effect. With ordinary magnet, the tangential effect is very weak and need to be amplified. In the U-turn wires the current makes a turning in each wire and the collected tangential force is multiplied by the number of turns of the coil.

The U-turn wires unveil a new effect: as I_2 and I_3 are of equal intensities, they should transfer equal tangential force of opposite direction which should cancel each other. But they do not. Why?

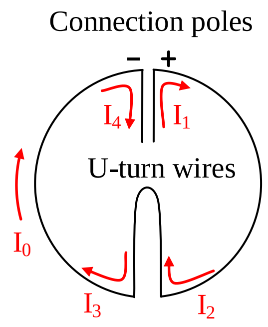

Figure 9

Figure 10

3. Comments

The conclusion of this experiment is that tangential force effect exists generally in magnetic field. I have already found this in 2 experiments in April 2013 that are shown in these videos: http://youtu.be/KHdAZhTGtWQ and http://youtu.be/D02LgnvT418.

The second important discovery is the U-turn wires effect which reveals that the same current turning the same angle does not transfer necessarily the same force. It is also interesting to notice that without the U-turn wires the tangential force on a coil is so weak that it is easily neglected. This is probably one of the reasons that this force has been invisible for so long.

Now, as I have shown that quadripole magnet and U-turn wires can multiply tangential force, its industrial applications will soon be invented. I think this principle is suitable for thin motor and actuator in restricted spaces such as satellites or medical apparatus.

The tangential magnetic force motor is a reverse motor of the long known homopolar motor constituted with a rotating round magnet driven by a incoming current. Here are 2 videos of such motors: http://www.youtube.com/watch?v=7SADAnt3hpA
and http://www.youtube.com/watch?v=MaKbB0QffVc

What is the force that pushes the magnet? The Lorentz force law cannot explain. J. Guala-Valverde and R. Achilles of Confluencia Tech University – P. Huincul, Argentina, have published a study in which they suggested the action of tangential force. Here is their paper:
http://redshift.vif.com/JournalFiles/V15NO3PDF/V15N3VAL..pdf