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Mathematical Modeling of Linear Acceleration by using Magnetic Strips

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Abstract keywords

Permanent Magnets are known from thousands of years and this human eagerness to utilize magnetic force for useful work. Magnets have north and south poles, similar pole always repel and opposite poles attract to each other. Magnetic Strips are made of thousands of tiny magnets in similar arrangement in the form of long strip. In this article magnetic force behavior of magnetic strips over water surface in two different cases has been discussed. A linear acceleration is generated along the magnetic strip which is responsible for the motion of movable disk in both directions only by changing the inclination angle, and in second case the continuous force on the internal disk which makes the disk rotating over the water surface. Experimental result is explained by using mathematical modelling.

keywords: Magnetic force; Magnetic strips

Introduction

Magnetism is basically a non-contact force. It is the core of attraction and repulsion without having to touch the object they are attraction or repulsion. Accordingly, herein below I represent the model elucidating the study based on above theory [1]. There is no gravitational force interference if water used as floating medium [2].

Magnetic force Vs Electrostatic force

Magnetic force direction is calculated by assuming North Pole behaviors in magnetic field similar as positive charge behavior in electrostatic field as shown in (**Figure 1**).

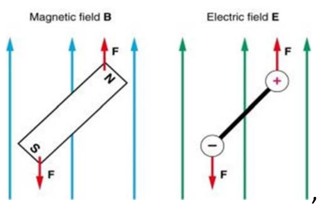

Figure 1: Magnetic force direction.

When a movable magnetic strip placed at an angle in the field of fixed magnetic strip, it will feel a force in the arrow direction as shown in (**Figure 2).**

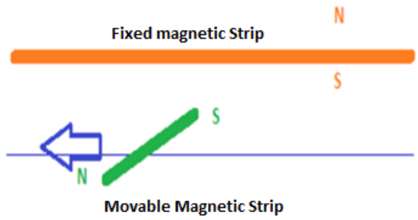

Figure 2: Magnetic force direction on movable strip.

Magnetic strips

Different types of magnetic strips are available in the market (**Figure 3**).

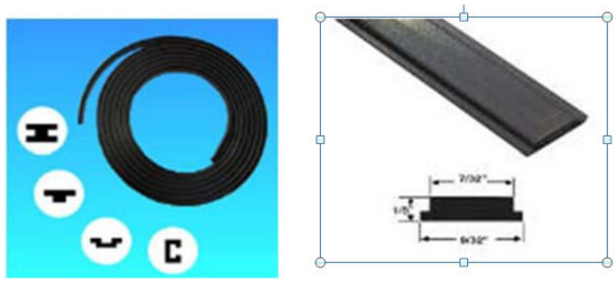

Figure 3: Types of magnetic strips.

In this experiment T-shape of magnetic strip are used in **(Figure 4).**

Figure 4: Types of magnetic strips used in the experiment.

Example of physical properties of magnetic strips are given below **(Table 1)**.

Code	Tensile Strenght (MP a)	Elongati on Rate	Hardnes s (SHA)	Tempera ture (oC)	Density (g/cm3)

DXZJ-1	5-10	30-100	85-98	-10-80	3.6-3.7
DXZJ-2	5-10	40-100	85-98	-10-80	3.6-3.7

Table:1 Physical properties of extruded magnetic strip.

Polarity of magnetic strips

In this study as shown above conventional through thickness type of magnetic strip is used. Magnetic strips have magnetic poles on each surface (**Figure 5).**

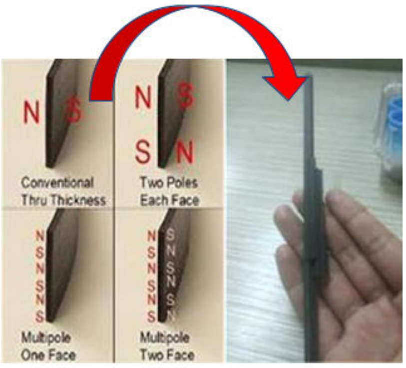

Figure 5: Magnetic strips polarities.

Methods

Liner acceleration over water surface has been shown with two experiments.

In first experiment a long magnetic strips used, which have thousands of poles on each edge [3]. When a small magnetic strip is placed over water surface inside the disk, disk moves along the long magnetic strip as the water surface is efficient to detect a minute magnetic force in slow motion as shown (**Figure 6).**

Figure 6: Magnetic strips arrangements in first experiment.

In second experiment external magnetic strip is fixed with the outer circular bucket containing water and the internal magnetic strip is tied to the inner circular disk placed over the water surface as shown in [4]. The continuous rotation of internal disk is by maintaining the fixed distance between two disks either point ‘A’ or ‘B’. If fixed distance is set at point ‘A’ the internal disk rotate clockwise and if the fixed distance is set at point ‘B’ the internal disk rotate anticlockwise (**Figure 7).**

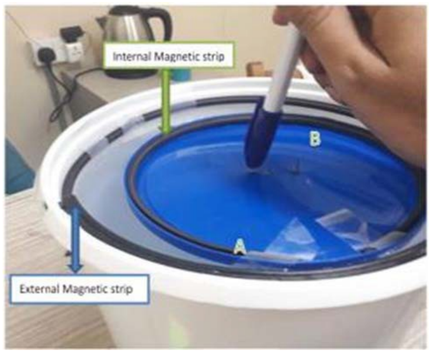

Figure 7: Magnetic strips arrangements in second experiment.

Results

Experiment 1

The direction of force on small disk changes with change of orientation of small magnet inside disk over water surface [5]. Small disk moves left to right in if only angle of small magnetic strip changed to 180 Degree and others all parameter are constant, small magnetic strips inside disk will move left to right direction as sho wn in **(Figure 8.1-8.5).**

Figure 8.1: Small magnetic strip start moving left to right.

Figure 8.2: Small magnetic strip moving left to right.

Figure 8.3: Small magnetic strip moving towards right end.

Figure 8. 4: Small magnetic strip moves from right to left.

Figure 8. 5: Small magnetic strip moves from right toward left end.

Experiment 2

Linear acceleration on the periphery of inner magnetic strip ring due to repulsion forces [6]. If we maintain the fixed distance either at Point 'A' it start rotate in anticlockwise direction as shown in **(Figure 9.1-9.3).**

If the fixed distance maintained by external (hand) [7]. During rotation of inner ring it will continuous rotate in clockwise direction **(Figure 9.4-9.6).**

Anti-Clockwise rotation

Figure 9.1: Rotation due fixed distance maintain at point 'A'.

Figure 9.2: Rotation due fixed distance maintain at point 'A'.

Figure 9.3: Rotation due fixed distance maintain at point 'A.'

Clockwise rotation

Figure 9.4: Rotation due fixed distance maintain at point 'B'.

Figure 9.5: Rotation due fixed distance maintain at point 'B'.

Figure 9.6: Rotation due fixed distance maintain at point 'B'.

Mathematical modeling

Mathematical model is derived on the bases of below assumption

Assumption

1. Outer ring magnet strip only North Pole considered, S pole will also have some effect will not affect the direction of net force.
2. Force due to others segment will be canceled each other due to symmetrical magnet strip both side.
3. Magnetic field of magnetic strip assume uniform along its whole length
4. Measurement of force unit during curve plotting considered to analyze the shape of curve only.

Discussion and Conclusion

A linear acceleration is generated along the magnetic strip in first case which is responsible for the motion of the small disk in both directions only by changing the inclination angle, and in second case the continuous force on the internal disk which makes the disk rotating over the water surface. Rotating motion is possible without hand (external) support by fixing the distance mechanically. The force behavior in both experiment are explained by using mathematical model where Fx is greater that Fy , this conditioned can be used as output work that can be done by Fx will be greater that input work done to maintain the fixed distance between two points. Computer simulation of Magnetic field and comparison of experimental force with the calculated forces are under development.

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