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APPLICATION OF MAGNETIC FORCE TO MEANS OF TRANSPORTATION MAGNETIC LEVITATION HIGH-SPEED RAILWAY

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Abstract

A magnet or magazine is an object that has a magnetic field. Magnets can also be interpreted as objects with symptoms and properties affecting certain materials around them. Magnetic force is one part of the electromagnetic force, where the other force becomes the fundamental force of nature caused by the movements of charge. Because magnets only attract particular objects, they can also not work or are not stylized, or there can even be a rejection of some particular objects on the magnet. The new generation of transportation is fast, reliable, and safe. In addition, it is also convenient, environmentally friendly, easy maintenance, and supports mass transportation. Magnetic levitation (maglev) trains are among the best candidates that meet these requirements.

Keywords: Magnetic Force, Means of Transportation, Magnetic Levitation

1. Introduction

Transportation is essential in all aspects of life, especially economics. Transportation is the backbone of the nation to the rural economy. With a sound transportation system, the level of welfare can be evenly distributed throughout the area. The increasing need for transportation systems that are faster, efficient, convenient, and environmentally friendly than the need for transportation development. The new generation of transportation is fast, reliable, and safe. In addition, it is also convenient, environmentally friendly, easy maintenance, and supports mass transportation. Magnetic levitation (maglev) trains are among the best candidates that meet these requirements. Conventional trains travel using friction between the wheels and the rails, while maglev replaces the wheels with electromagnets and hovers over the rails, generating electro-mechanical thrust without contact. Advances in magnetic technology allow objects to be concentrated with magnetic force. With this technology, the loss due to friction between the workpiece and its foundation can be eliminated. The expansion and denseness of activities carried out by humans over time in various ways will encourage us as creatures with the intelligence to make breakthroughs to facilitate daily activities. Until now, technology has developed rapidly along with many inventions in various fields of science. Physical science is a scientific field that dramatically influences technology development today. Humans later developed the discovery by creating a magnetic field using electric current to produce a magnetic field called an electromagnet. This electromagnet allows humans to utilize it in various fields.

The field of transportation is one of the applications of electromagnetic technology. Magnets combined with various other technologies such as superconductors and electromagnets can make an object float. This

phenomenon is called Magnetic Levitation or maglev. The breakthrough of the application of maglev is currently also used as an innovation of land transportation means, in this case, the railway (train). In its development, researchers continue to make breakthroughs with its primary medium, magnetism. One of the most recent breakthroughs today is magnetic levitation, or maglev for short, by using a repulsive force between magnets to float an object or vehicle. Conventional trains are a means of land transportation and have long served people worldwide. Conventional trains that we know today have several shortcomings. They are noisy (due to friction between two objects) and only sourced from electrical energy. No alternative energy cannot go at high speeds, which are some of the conventional trains' shortcomings. Maglev trains use electromagnets to counter the gravitational force of an object, so it can float in the air without anyone holding it. Maglev trains move in the absence of bearings, shafts, and wheels, so maglev can move more smoothly and are less noisy than trains in general because, on maglev trains, there is no friction between the wheels and the rails. Existing maglev trains only use electrical energy and do not use alternative energy such as solar heat, wind, or other energy sources.

Theoretical Studies

Magnet or magazine is an object that has a magnetic field. Magnets can also be interpreted as objects with symptoms and properties affecting certain materials around them. Magnets are derived from the Greek magnetic lithos, which means magnesian stone. Magnesia is a region in ancient Greece where many magnetic stones were found. Each magnet has two poles: north (N) and south (S). The magnetic pole is the area at the ends of the magnet with a tremendous magnetic force at its poles. Based on their origin, magnets are divided into two groups, namely:

- Natural magnets are magnets found in nature. The Earth is a giant natural magnet; therefore, it has the north and south poles as its magnetic tip. Natural magnets can be found on rocks that contain magnetic elements. Rocks that can pull objects from iron are called natural magnets.
- Artificial magnets, which are magnets that humans deliberately make. Furthermore, based on their magnetic properties, artificial magnets are grouped into fixed (permanent) and temporary magnets. Fixed magnets are magnets whose magnetic properties remain and occur for a relatively long time. In contrast, temporary magnets are magnets whose properties are not fixed or temporary. Permanent (fixed) magnets are generally made of steel, while non-fixed magnets are made of soft iron. Adapted to its usefulness, today, magnets are made of several types of metals.

2. Research Methods

This study used literature review methods to collect, identify, and evaluate the application of magnetic force in the transportation of magnetic levitation fast trains. The data source used in this study is a secondary data source, where data obtained through databases from Pubmed, Elsevier, and Google scholar is used to search for relevant journals. The journals obtained are selected based on the title made by the author. The journal selection is carried out following the relationship of the title with conclusions that tell about the application of magnetic force in the means of transportation of magnetic levitation fast trains. In the search results, there are 15 subsequent journals sorted that meet the criteria for review of as many as 5 Journals. This research also uses other methods in the form of library reviews from various sources such as articles, books, newsletters, news, and other documents that describe the state of knowledge in the past and present on the topic of research.

3. Result and Discussion

Magnetic force is one part of the electromagnetic force, whereas the other force becomes the elemental force of nature caused by the movements of charge. Because magnets only attract particular objects, they can also not work or are not stylized at all, or there can even be a rejection of some particular objects on the magnet. In this case, there will be a pull if it contains a charge with the same direction of motion. At the same time, it will move in a direction if it has a repulsive force between the two objects. It is considered a form of tensile and repulsive energy between magnetic poles and electrically charged motion particles. This charge of motion will then create a magnetic field that interacts to give rise to the magnet.

3.1. Application of magnetic force

Ferromagnetic is one form of object that can be strongly pulled by magnetism or has a powerful magnetic force. If this type of object is near the magnet, it will be attracted by the magnetic object. Because of the strong magnetic force in ferromagnetic, this material can also be used as a magnet itself. Examples of magnetic or ferromagnetic objects are iron, nickel, steel, and cobalt. Some countries apply magnetic force to maglev trains based on the latest development results.

3.1.1. Japan

Japan is one of the countries that excels in the field of Kerata Maglev. In 1964, the Japan Railway (JR) Central railway company opened its first high-speed rail service, the Tokaido Shinkansen from Tokyo to Osaka round and forth.

Figure 1 Japan Railway (JR) Central Train

3.1.2. France

France pioneered the presence of high-speed rail in Europe via train à grande Vitesse (TGV), which operated for the first time in 1981, connecting Paris and Lyon. TGV is the record holder of conventional electric rail speeds. On 3 April 2007, the TGV type V150 managed to break the record for a top speed of 574.8 km / h on the Ligne à Grande Vitesse (LGV) Est high-speed railway line between Paris and Lyon.

Figure 2 Ligne à Grande Vitesse (LGV)

3.1.3. Germany

Germany is launching the Inter City Express or ICE high-speed rail service. The high-speed railway operated by the Deutsche Bundes Bahn (DB) rolled in 1985 with an operational speed of 300 km/h. The train, identical to the red-striped white color, serves routes to several neighboring Countries of Germany, such as Switzerland and Austria. ICE also serves routes to the Netherlands and Belgium, but the routes of the two countries are served at low speeds.

Figure 3 Inter City Express or ICE Trains

3.1.4. China

The development of high-speed railway technology in China is very rapid. In less than 20 years, or precisely since 2007, more than 37,000 km of high-speed railways have been built in the country. High-speed railways in China were initially imported or built under technology transfer agreements with the world's leading railway makers such as Alstom (France), Siemens (Germany), Bombardier (Germany), and Kawasaki Heavy Industries (Japan).

Figure 4 Chinese State Development Train

3.1.5. Russia

Not the latest, let alone the most advanced. However, Russia has the longest railway line in the world, the Trans-Siberian Railway, which starts in Moscow and passes through Yaroslavl, Chelyabinsk, Omsk, Novosibirsk, Irkutsk, Ulan-Ude, Chita, and Khabarovsk to Vladivostok via southern Siberia. The railway, built-in 1891 to 1916, stretches for 9289 kilometers.

Figure 5 Trans-Siberian Railway

3.2. Working Principles

In general, the working principle of the Maglev train is to utilize the repulsive force and attraction between the magnetic field on the railway (railway) and the train itself. So, it can be concluded that to make this train lift from its trajectory requires a powerful magnetic field. Of course, getting a solid magnetic field requires many rod magnets, but applying Lenz's law can solve the problem. Lenz's law mentions that the current of impact will appear in such a beautiful direction that the direction opposes the change that produces it. Based on the above statement, it can be concluded that Lenz's law only applies to a series of closed room conductors. So if there is a change in magnetic flux in the space surrounded by a wired system that forms a closed coil (closed system circuit), it will create a magnetic field that fights changes in magnetic flux in the system. The magnetic lift can be seen based on the magnetic material and system that can pull or press each part (between the train and the track wall) together with the force that depends on the magnetic field and the area of the magnet itself so that the magnetic pressure can be known. The magnetic pressure of the magnet can be calculated using the following formula. Usually, the design of this Maglev train is made streamlined (slim) or aerodynamics that aim to reduce friction to the air so that this train can move quickly, considering there is no friction between the train and the track.

4. Conclusion

The new generation of transportation is fast, reliable, and safe. In addition, it is also convenient, environmentally friendly, easy maintenance, and supports mass transportation. Magnetic levitation (maglev) trains are among the best candidates that meet these requirements. The application of magnetic force on maglev trains in several countries is based on the results of the latest development, namely:

- Japan is one country that excels in the Kerata Maglev field. In 1964, the Railway Company Japan Railway (JR) Central.
- France is the country that pioneered the presence of high-speed trains in Europe via Train à Grande Vitesse (TGV)
- Germany launched the InterCity Express or ICE high-speed rail service in 1985 with an operational speed of up to 300 km/h
- High-speed railways in China were initially imported or built under technology transfer agreements with the world's leading railway makers such as Alstom (France), Siemens (Germany), Bombardier (Germany), and Kawasaki Heavy Industries (Japan)
- Russia has the longest railway line in the world, the Trans-Siberian Railway, which starts in Moscow and passes through Yaroslavl, Chelyabinsk, Omsk, Novosibirsk, Irkutsk, Ulan-Ude, Chita, and Khabarovsk to Vladivostok via southern Siberia.

Ferromagnetic is one form of object that can be strongly pulled by magnetism or has a powerful magnetic force. If this type of object is near the magnet, it will be attracted by the magnetic object. Due to the strong magnetic force in ferromagnetic, this material can also be used as a magnet itself.

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