revolution. I, for one, am looking forward to skimming across the countryside in a levitating box of magnets at 300 mph.

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THE USAGE OF SUPERCONDUCTING MAGNETS IN RAIL TRANSPORT

Dauletov Akadil Ayboluly
akadil_d@mail.ru
Student of the Department of Organization of transportation, traffic and operation of transport
ENU L.N.Gumilev, Nur-Sultan, Kazakhstan
Supervisor – M.I.Arpabekov

Half a century ago, the magnetic pillow and it`s usage was something out of the realm of science fiction. However, now scientists in many countries are working to create a transport on a magnetic cushion. The trains of the future will «hover» above the ground, they are «suspended» from the rails, or repelled from them, depending on what system will be used, that is, electromagneticsuspension.

Developments in the field of magnetic levitation have been carried out since the beginning of the XX century. A significant number of scientific achievements belonged to the USSR, which in the 60s of the twentieth century was one of the world leaders in the development of magnetic levitation systems. The practical application of the phenomenon of magnetic levitation is currently diverse: in micro-and nanotechnology, in the production of certain equipment and devices, in the transport industry. Due to the increasing complexity of the technical and technological level of society and the emergence of opportunities for implementing science - and capital – intensive projects in the transport sector, a partial transition to the use of magnetic levitation trains - "transport of the future" - becomes relevant and promising.

We know about the basic properties of magnets from the physics lessons for the 6th grade. If you bring the north pole of a permanent magnet to the north pole of another magnet, they will repel. If one of the magnets is turned over, connecting the different poles, it will attract. This simple principle is laid down in maglev trains, which glide through the air above the rail at a small distance [1].

Magnetic suspension technology is based on three main subsystems: levitation, stabilization, and acceleration. At the same time, at the moment there are two main technologies of magnetic suspension and one experimental, proven only on paper.

Maglev trains are the fastest type of ground-based public transport. And although only three small tracks have been put into operation so far, research and testing of magnetic train prototypes are taking place in different countries. How the technology of magnetic levitation developed and what awaits it in the near future, you will learn from this article [2].

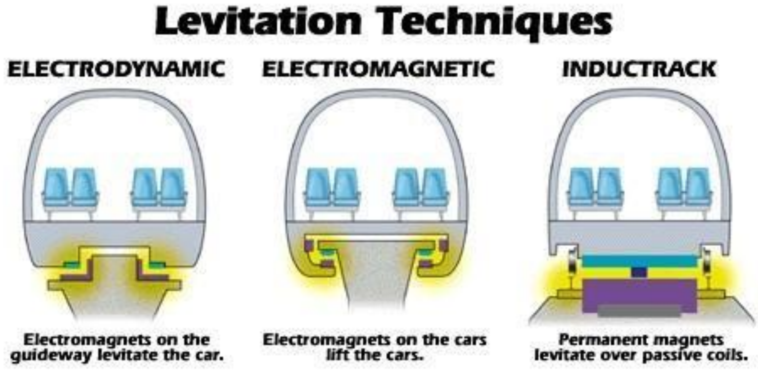

Figure 1. Types of train levitation

The first pages of the history of maglev were filled with a series of patents obtained at the beginning of the XX century in different countries. Back in 1902, the German inventor AlfredaSeiden was awarded a patent for the design of a train equipped with a linear engine. Four years later, Franklin Scott Smith developed another early prototype of an electromagnetic suspension train. A little later, in the period from 1937 to 1941, several more patents related to trains equipped with linear electric motors were obtained by the German engineer Hermann Kemper. By the way, the rolling stock of the Moscow monorail transport system, built in 2004, uses asynchronous linear motors for movement – this is the world's first monorail with a linear motor.

Trains built on the basis of electromagnetic suspension technology (EMS) for levitation use an electromagnetic field, the strength of which varies over time. At the same time, the practical implementation of this system is very similar to the operation of conventional railway transport. Here, a T-shaped trackbed made of a conductor (mostly metal) is used, but the train uses a system of electromagnets instead of wheel pairs – support and guides. In this case, the supporting and guiding magnets are located parallel to the ferromagnetic stators located at the edges of the T-shaped path. The main drawback of the EMS technology is the distance between the reference magnet and the stator, which is 15 millimeters and must be controlled and adjusted by special automated systems, depending on many factors, including the unstable nature of the electromagnetic interaction. By the way, the levitation system works thanks to the batteries installed on board the train, which are recharged by linear generators built into the support magnets. Thus, in the event of a stop, the train will be able to levitate on the batteries for a long time. Transrapid trains and, in particular, the Shanghai Maglev are built on the basis of EMS technology [3].

Trains based on EMS technology are driven and decelerated by a low-acceleration synchronous linear motor, represented by support magnets and a trackbed over which a magnetoplane hovers. By and large, the motor system built into the web is a conventional stator (the stationary part of a linear electric motor), deployed along the lower part of the web, and the supporting electromagnets, in turn, work as an armature of the electric motor. Thus, instead of generating torque, the alternating current in the coils generates a magnetic field of excited waves that moves the composition contactlessly. Changing the power and frequency of the alternating current allows you to adjust the traction and speed of the train. In this case, to slow down, you just need to change the direction of the magnetic field.

In the case of electrodynamic suspension (EDS) technology, levitation is carried out by the interaction of the magnetic field in the web and the field created by superconducting magnets on board the train. Japanese JR-Maglev trains were built on the basis of EDS technology. Unlike EMS technology, which uses conventional electromagnets and coils conduct electricity only when power is applied, superconducting electromagnets can conduct electricity even after the power source has been disconnected. By cooling the coils in the EDS system, you can save a lot of energy.

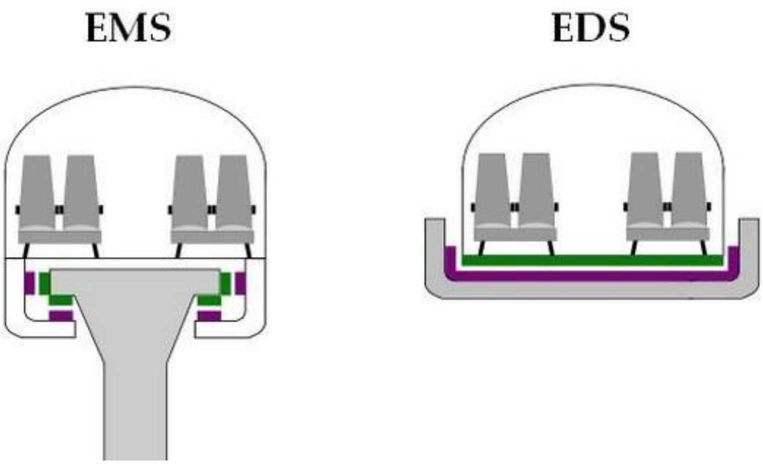

Figure 2**.** The main advantage of the system EDS

The main advantage of the EDS system is high stability – with a slight reduction in the distance between the web and the magnets, a repulsive force occurs, which returns the magnets to their original position, while increasing the distance reduces the repulsive force and increases the attractive force, which again leads to the stabilization of the system. In this case, no electronics are required to monitor and adjust the distance between the train and the track. What's more, superconducting coils are required to charge only ones to produce circulating one-directional flow of electric charge forever with no energy loss. However, there is another scenario. Due to the fact, that one of the ways to increase the efficiency of trains on a magnetic cushion is the use of superconductors, which, when cooled to near absolute zero temperatures, completely lose electrical resistance. Moreover, it is very expensive to keep huge magnets in tanks with extremely cold liquids, because to keep the desired temperature, you need huge «refrigerators», which further increases the cost [4].

There were also drawbacks for certain amount of time, such as – the force sufficient for the levitation of the composition occurs only at high speeds. For this reason, the train on the EDS system must be equipped with wheels that can provide movement at low speeds (up to 100 km/h). Appropriate changes must also be made along the entire length of the track, as the train can stop at any place due to technical malfunctions.

It is also worth noting that the strong magnetic fields in the passenger section make it necessary to install magnetic protection. Without shielding, traveling in such a car for passengers with an electronic heart stimulator or magnetic data carriers (HDD and credit cards) is contraindicated. In addition, superconducting magnets are one of the most powerful and efficient form of electromagnets, which leads to lots of energy consumption and demand to keep coils in superconducting stage.

Thus, results of thestudy allowed us to form certain conclusions regarding high-speed trains and their impact on the environment. For instance, onboard liquid helium refrigeration system is used in purpose of solving energy consumption. The superconductors in the Maglev train aremadeof niobium titanium alloy, which has critical temperature of 9.2 Kelvin and to keep the alloy temperature below this limit – liquid helium at a temperature of 4.5 Kelvin is circulated around it. After passing over the conductor, the liquid helium evaporates.To bring it back to the initial stage a helium compressor and refrigeration unit is used. The refrigeration unit works on the principal of Gifford-McMahon refrigeration cycle, which is gathered in cryogenic department with additional systems.

Along the previous technology, Cryogenic department also has to prevent superconductors from absorbing the heat of outside, in the form of radiation. To accomplish this task a radiation shield is added around it. Whereas, during the movement of the train, any current formation and heating issues might happen in this shield, which should be neutralized. To solve this issuewe need to use radiation shield, that requires cooling through the supplying of liquid nitrogen to the unit. In addition, to prevent convective heat transfer, a vacuum is maintained inside the radiation shield.

As a result of the above, superconductors with opposing current polarity are arranged in a unit and linked to the cryogenics department with attachment along the length of the train on both sides. Nevertheless, magnetic field produced by the superconductors still might have hazard on the health of passengers. To avoid such negative effect, magnetic shields are used on the rolling stock and passenger embarkation facility. Therefore, maintaining the magnetic radiation below the necessary level of ICNIRP guidelines. To sum up, results of thestudy allowed us to form certain conclusions regarding high-speed trains and their impact on the environment. Passenger high-speed rail lines are rapidly gaining popularity as a leading role in transport planning. Given the development of different types of alternative energy, such as wind, solar, and biomass energy, it can be assumed that alternative energy in the transport sector will be implemented successfully.

Maglev trains are considered one of the most promising modes of transport of the future. From ordinary trains and monorails, trains on a magnetic cushion are distinguished by the complete absence of wheels – when moving, the cars seem to hover over one wide rail due to the action of magnetic forces. As a result, the speed of such a train can reach 400 km / h, and in some cases, such transport can replace an airplane. Maglev system and technology will involve masses of work in saving energy and protecting environment even in advanced countries

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FEATURES AND PROBLEMS OF THE MARKET FOR THE PROVISION OF REGULAR PASSENGER ROAD TRANSPORT SERVICES

Maldybayeva Meruyert
arpabekov_m@mail.ru
Student of the Department of Organization of transportation, traffic and operation of transport
ENU L.N.Gumilev, Nur-Sultan, Kazakhstan
Supervisor – M.I.Arpabekov

Abstract. The article considers the features and problems of the market for the provision of regular passenger road transport services, as well as the solution to these problems. Recommendations for the further development of road transport services were noted.

Introduction

World experience demonstrates that in the leading countries of the world special attention is paid to the transport infrastructure market as well as economic responsibility, flexible management costs, and use of resources to maximize profits.

Nowadays the provision of transport services to consumers takes place in accordance with established regulatory legal acts and allocated conditions for specific routes.

The main principles of organizing regular passenger road transport are:

- ensuring the safety of passenger traffic;