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ОРГАНИЗАЦИЯ ПЕРЕВОЗОК, ДВИЖЕНИЯ И ЭКСПЛУАТАЦИЯ ТРАНСПОРТА. ЛОГИСТИКА

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MAGLEV`S TECHNOLOGY PRINCIPLES

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Consider a train that has no wheels. Instead of rolling along the track, it hovers above it, softly gliding from point A to point B without ever hitting a rail. Although this may sound like science fiction, examples of this technology can already be found in a number of locations throughout the world. Maglev trains are what they're called (derived from the term magnetic levitation). These future locomotives open up a world of new and thrilling travel options. They have the potential to be more energy efficient, faster, and safer than traditional transportation methods. Despite the fact that such trains are few and few between at the moment, they are a beehive of study in the field of electrical engineering. As a result, maglev might become more prevalent than you think.

Recently, the aerodynamic characteristics of the rolling stock have been significantly improved. The resistance to movement of modern electric trains of the Shinkansen network (Japan) at a speed of 300 km/h is approximately the same as that of trains of the previous series of the same length (400 m) at a speed of 220 km/h. This, among other things, allows you to reduce the power consumption for traction.

Further improvement of the rolling stock is necessary to expand the range of lines for regular trains running at a speed of 300 km / h or more. The priority is the introduction of the following technical innovations:

- wheel-to-rail traction control systems that ensure effective acceleration of the train and its steady movement at a speed of more than 300 km / h, even in conditions of poor traction (for example, when the rails are covered with a crust of ice);
- design solutions that further reduce the resistance to movement (especially in the space between the bottom of the car bodies and the track);
- design solutions for rolling stock and track that reduce the impact interaction between the wheel and the rail;
- more efficient mechanical brake designs and other auxiliary brake systems;
- design solutions for the rail track, allowing the effective use of the eddy current brake.

It is also very important that passengers make effective use of their time on the train during the journey. For example, passengers in Europe and the United States often use personal computers on the way, so it is desirable to have as low a vibration level as possible. In the near future, the use of Internet services will expand, for which appropriate on-board devices should be provided.

Since the high-speed train refers to passenger trains that travel from 200 to 300 km per hour, the technology of developing a high-speed railway is based on a system of special tracks for such a train. A high-speed rail system usually requires an existing railway track, or may use separate, specially designed tracks, known as' special ' rail tracks. Due to economic considerations, most high-speed trains in the world use existing railway tracks only recently constructed tracks designed for high-speed travel [1].

For example, the technology of jointless rails, when the rails are soldered into kilometer-long lashes and in this form are delivered on a platform to the place of laying. At the same time, the rails are structurally made in such a way that to compensate for the temperature expansion at the gap point, they «slide» relative to each other, since the ends of the rail are cut in the form of a triangle, where the long leg is the outer side of the rail, and the very elongated hypotenuse is the edge tightly adjacent to the other rail. In a normal track, the rails are laid with straight edges to each other, with a fairly large gap to avoid mutual compression or bending.

Specially designed high-speed trains must travel on tracks designed from certain materials that can withstand the available weight, speed of the train and have normal track wear.

Due to the high speeds, the signal structures at different stations are designed to allow high-speed trains to gradually reduce speed as they approach the station, so that technical staff can coordinate the movement of other trains. In addition, of great importance for safe movement are «wheel pairs (bogies)» - structures that are placed under the car and serve to support the mass of the train; must ensure stability when the train is moving on straight and turning tracks; absorb vibrations coming from the tracks; reduce the effect of centrifugal forces that affect people when the train is moving along a curve at high speeds. Therefore, companies that have modern high-speed trains always interact with the local authorities that manage the railway tracks, maintaining them at an up-to-date level.

Together with the maintenance of existing tracks and the design of special new tracks, there is a need to develop electric generators for high-speed movement, the so-called «service warehouses». Power stations are extremely important in the work of servicing high-speed trains. Typically, a high-speed train car is equipped with electrical control modules that communicate with a power plant located along the track. These technical features are important in the event that a high-speed train car is moving at an excessive speed, when the electrical control modules detect this problem, the braking system in the entire train is automatically activated[2].

Maglev trains are a new and promising direction for the development of high-speed rail transport. Research on this type of transport began in the middle of the last century: a patent for a maglev train was obtained in June 1941, and the first commercial line using these trains was introduced in 1984 in Britain. The line was low-speed, and in 1995 it was closed, considered unsafe.

With the introduction of superconductors in this industry, it became possible to switch to high-speed rail transport. To date, the main representatives for the creation of high-speed ground transport are Japan and Germany. The leader in this industry is Japan.

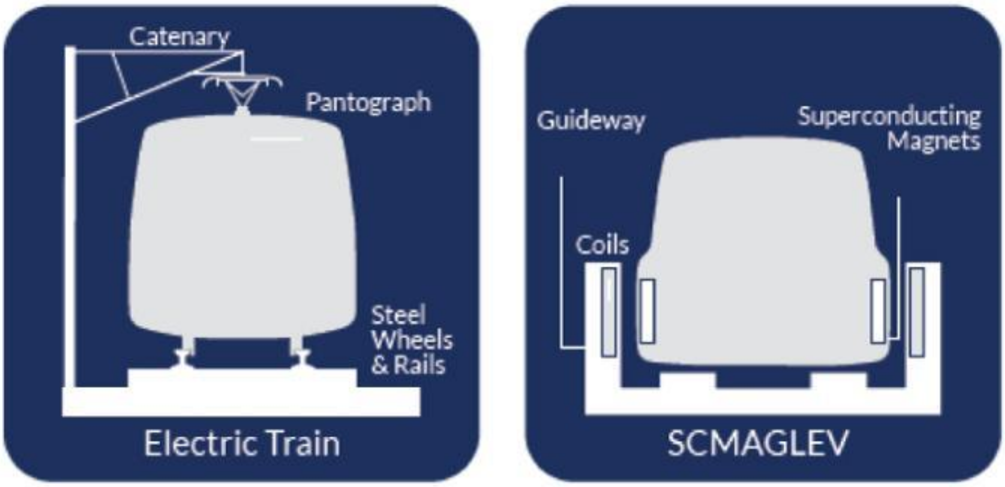

Figure 2. Electric train versus SCMaglev.

Propulsion is the force that drives the train forward. Maglev uses an electric linear motor to achieve propulsion. A normal electric rotary motor uses magnetism to create torque and spin an axle.

It has a stationary piece, the stator, which surrounds a rotating piece, the rotor. The stator is used to generate a rotating magnetic field. This field induces a rotational force on the rotor, which causes it to spin. A linear motor is simply an unrolled version of this (see Figure 2). The stator is laid flat and the rotor rests above it. Instead of a rotating magnetic field, the stator generates a field that travels down its length. Similarly, instead of a rotating force, the rotor experiences a linear force that pulls it down the stator. Thus, an electric linear motor directly produces motion in a straight line. However, this motor can only produce a force while the rotor is above the stator. Once the rotor has reached the end, it stops moving[3].

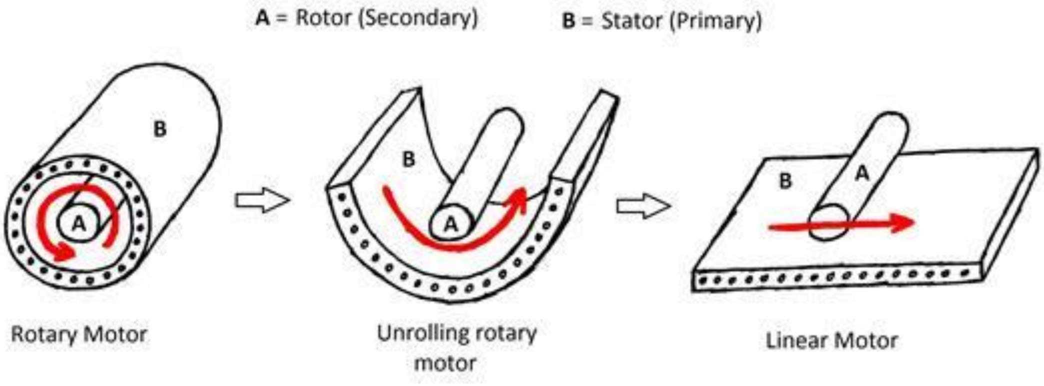

Figure 2. Rotary motor versus linear motor.

When describing a linear motor, the standard is to use the term “primary” instead of “stator,” and “secondary” instead of “rotor.” In maglev trains, the secondary is attached to the bottom of the train cars, and the primary is in the guideway. So a magnetic field is sent down the guideway and it pulls the train along after it. In a way then, the entire length of a maglev track can be considered to be part of the train’s motor. The system that has been described so far is a Linear Induction Motor (LIM). It is so called because the magnetic field in the primary *induces* a magnetic field in the secondary. It is the interaction between the original field and the induced field that causes the secondary to be pulled along. However, in this configuration, the secondary always lags somewhat behind the moving field in the primary. This lag is a source of energy and speed loss. In a Linear Synchronous Motor (LSM), the lag is removed by attaching permanent magnets to the secondary. Because the secondary is now producing its own stationary magnetic field, it travels down the primary in sync with the moving field—hence the name for this variant of motor (Gieras, 2011). Because LSMs are faster and more efficient, they are the motor of choice in high-speed maglev trains[4].

Guidance is what keeps the train centered over the guideway. For high-speed maglev, repulsive magnetic forces are used to achieve this. In the TransRapid, there are two electromagnetic rails placed on the train facing either side of the guideway. These rails keep the train from moving too far off course. In the MLX, guidance is coupled with the levitation system. The levitation rails on either side of the train are connected to each other. Through this connection, when the train moves closer to one side a restoring force is induced which pushes it back towards the center. Thus the MLX is both levitated and guided at the same time.

Maglev technology has a bright future ahead of it. It has the potential to be a more affordable, faster, safer, and environmentally friendly mode of transportation than we now have. It will become all of these things with the help of certain electrical engineers. This technology might be used for everything from intercity public transportation to cross-country travel. There are also plans to construct lengthy underground tubes, suck the air out of them, and then install maglev trains inside. Because there would be essentially little wind resistance in this environment, a train might quickly exceed the speed of sound.While it may take a long time for this technology to become widely used, it is difficult to deny that it will eventually become such. The benefits are far too many to be overlooked. There is now only one commercial maglev train in existence, and it has already surpassed all previous models. Furthermore, it is quite likely that we are on the verge of a transportation 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

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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].