

THE DEVELOPMENTS OF HYBRID ROAD-RAIL ROLLING STOCK IN RUSSIA

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ABSTRACT

The article deals with the aspects of the development of hybrid road-rail rolling stock – automotive tractors of various purposes equipped with devices for movement along the railway track. Information is provided on the design features, single and serial models of machines built by the plants of

the USSR and modern domestic enterprises. Depending on the specificity and type of hybrid road-rail equipment, the author identifies the current problems and directions of development of hybrid road-rail vehicles, the design and production of which are designed to become at least ordered, technological and standardized.

Keywords: hybrid road-rail transport, rolling stock, road transport, rail transport, innovations.

Background. The innovative development in the sphere of transport ensures the renewal of fixed assets, efficient work and interaction of various types of equipment, improves the transport accessibility of the population and integration with transport systems of other states. The introduction of new science-intensive technologies makes it possible to achieve an integrated balanced transport progress, to increase its safety level and the productivity of cargo transportation.

Let's consider as an example of advanced technical means and new technologies in the field of transport, a special type of rolling stock, developing in Russia, – hybrid road-rail machinery of various purposes.

Objective. The objective of the author is to consider hybrid road-rail vehicles in Russia and, in particular, its development.

Methods. The author uses general scientific methods, comparative analysis, evaluation approach, statistical data.

Results. Hybrid road-rail machinery (HRRM) – vehicles that can move both on the road and on the track by means of installed special equipment – additional wheels / rollers.

The basis for creating HRRM is: standard vehicles (general purpose, specialized, special), tractors, as well as types and kinds of machines designed and constructed for special purposes.

Arrangement of HRRM can be divided into three parts:

1. **Basic chassis** – passenger car or truck or tractor, specially modified for the installation of railway equipment and work on the network (equipping with the communication system, alarm system, train braking system, sound alarm, coupling devices, etc.).

2. **Rollers / additional bogies – rail wheels** [3], designed to hold HRRM on rails and serving as guides for movement due to the presence of flanges. They are attached to the modified frame of vehicles, from below, near the tractor wheels.

3. **Superstructure** – various types of bodies or special equipment, installed on the basis of HRRM, depending on the scope of application.

Currently, there are two versions of the hybrid road-rail mechanism: guiding and driving [2]:

- **guiding** – to ensure stability and direction: rail wheels do not interact with autotractor wheels (the propulsor is the main autotractor wheels, contacting the rail);

- **driving** – to carry out the movement: the rail wheels interact with the autotractor wheels (the autotractor wheels, without interacting with the rail, transfer the rotation to the rollers, thereby driving the HRRM).

The process of placing the hybrid road-rail machinery on a railway track is of two types:

1) **traditional:** the placing is carried out by direct HRRM arrival from the road (crossing) to the railway track. This requires an average distance of 5–10 m;

2) **using a hydraulic bearing-turning platform** – a special device located under the bottom of the vehicle. Then the placing is as follows:

- HRRM comes to rails perpendicular to them (for example, at the crossing);

- the hydraulic lifting device raises the HRRM to a small height;

- the turning mechanism turns the vehicle by 90°, placing it precisely above the railway track;

- lowering until the autotractor wheels are placed on the rails.

After placing by means of a hydraulic drive, the rail wheels (rollers, bogies) are lowered and HRRM is ready for operation.

The creation of domestic hybrid road-rail cars began in the first half of XX century. The basis was Soviet armored vehicles (for example, BA-64), so the first and only at that time, the customer and consumer of such equipment was the Red Army.

The creation of HRRM of civil purpose began in the 1950s. The first cars of this kind were cars that were mass-produced at the plants of the Ministry of Automotive Industry of the USSR, and later other departments equipped with the appropriate hybrid road-rail equipment. Depending on the tasks performed, this machinery was divided into five groups:

1. **Cars and buses of especially small class** as autotrains and light motorized locomotives for service transportations. The most widely used basic vehicle was the UAZ car (for example, passenger cars UAZ-469, UAZ-3151, etc., sanitary minibus UAZ-452A).

2. **Trucks as a traction unit (locomotive)** for shunting and export work. An example of the use of an onboard KrAZ-257 is known, capable of pulling on the rear coupling a composition weighing up to 1000 tons [4].

3. **Machines for performing loading and unloading operations:** HRRM based on automobile cranes and loaders. They were used for repairs on the railway, as well as at loading points for fine grade and bulk construction materials (due to the use of the feeding claw instead of the hook).

4. **Machinery for carrying out repair and track works:** special machines for both civil and military use, designed for construction, installation, repair and restoration and diagnostic work on the railway. An example of such a machinery is the VPR-600 flattener machine, consisting of a crawler hauling tractor with a turn plow and a hybrid road-rail technological trailer for repairing the track; the ballast leveling machine PB-3M, which includes a crawler hauling tractor with



Pic. 1. Mobile shunter TMV-2.

an additionally installed rail wheels and a trailed track-type machine for ballast distribution.

5. HRRM for military purposes, as well as performing fire, rescue and recovery operations in hard-to-reach places and difficult conditions. For example, the fire truck GAZ-59402 «Purga», the rescue vehicle GAZ-59401, the armored personnel carrier BTR-40ZhZ, equipped with a hybrid road-rail mechanism [5].

In Russia today HRRM of the following purpose is made:

- machines for shunting operations. So, LLC Miass factory of specialized cars produces a line of hybrid road-rail cars – «MART»: «MART-2» and «MART-3», positioned as an alternative to shunting locomotives. The motor locomotives MMT-2 and KPT-1 on the basis of wheeled tractors are manufactured by LLC Spetskran and LLC Rigel AV, respectively. RPC Uralvagonzavod designed and built a completely new type of HRRM – mobile shunter TMV-2, not based on any commercially available vehicle (Pic. 1);

- machines for track maintenance and repair. For example, the mobile defectoscope laboratory LDM-1 on the basis of UAZ-3160 «Patriot» (Pic. 2) and the rail-welding complex based on the shift bus VM-3284-0000010-03 on the chassis GAZ-3308 «Sadko» produced by CJSC Firma Tvema. JSC PO EIAZ produces a cargo-passenger machine GPM-K on the chassis of KamAZ-43118. LLC Rigel AV offers a universal track machine UPM-1 on the basis of the tractor HTZ-150K, which is equipped with various attachments.

Hybrid road-rail machinery has a number of advantages in comparison with the usual shunting locomotive, namely:

1. Universality.
2. Maneuverability.
3. The greatest efficiency.
4. Great economic benefit.
5. Easier maintenance and repair.

The use and further development of HRRM are expedient for operation at large industrial enterprises, in ports, repair points for rolling stock, track facilities, rescue and emergency recovery services. This makes it possible to conduct various transport, handling and special operations more quickly, with less expenses and time than traditional railway equipment, which is a very advantageous solution from the point of view of logistics.

Finally, it is worth noting that the introduction of hybrid road-rail machinery was also fixed at the regulatory and legal level. Thus, by the order of Russian Railways of February 6, 2014, No. 289r, «On approval and implementation of the temporary instruction for the operation of removable mobile hybrid road-rail units on the infrastructure of JSC Russian Railways», an instruction has been issued that establishes the procedure for operating the hybrid road-rail rolling stock, as well as the procedure for actions of employees in their operation [1].

Conclusions.

1. Further systematic and economically justified introduction of hybrid road-rail machinery of various types and kinds is necessary, taking into account foreign and domestic experience.

2. Priority directions of HRRM application in the «1520 space» at the initial stage: shunting work as a traction module at large sorting stations and nodes,





Pic. 2. Fault detection laboratory LDM-1.

industrial facilities and terminal-warehouse complexes; laboratory diagnostic and measuring, construction and assembly, repair and recovery and search and rescue operations as active units of wiring, repair, fire and military trains.

3. The development, design and production of rolling stock and equipment should be carried out by domestic enterprises, creating competition to foreign peers.

4. It is necessary to define a clear classification of the hybrid road-rail rolling stock in terms of design features and specialization, taking into account the specifics of the scope of application; to develop and agree on a system of designations for certification and production in accordance with the industry standard OH 025 270–66 (or other standard adopted by the manufacturer).

5. A unified terminological apparatus is required for the precise and non-alternative definition of the names of the hybrid road-rail rolling stock, its nodes, units and equipment, in view of the diversity of concepts and terms in its sources, which often causes confusion («locomobile», «locotractor», «rollers», «additional rail wheels»).

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