A method that improves the safety states of technical means of control and management

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Abstract. The main focal points of improving the traffic safety management system are as follows. First, one must coordinate the interaction among all functional branches, their structural divisions and subsidiaries involved in the transportation process, based on common approaches to managing processes related to traffic safety. Second, one should implement the approaches and requirements that are congruent with international standards; to maintain a positive level of traffic safety culture through awareness of the importance and social responsibility of the holding employees when performing work that affects traffic safety, with simultaneous integration of mandatory and strict rules of conduct in all production processes. Third, one is to improve the regulatory framework. Train traffic safety is ensured at all stages of the life cycle of rolling stock, traffic support systems and infrastructure elements. Nevertheless, failures and malfunctions are detected during the operation. This article presents one of the methods for increasing the train traffic safety in the automation and telemechanics system.

1. Introduction
Improving the railway transport safety is one of the most important goals of the reform, included in the structural adjustment program approved by the Government of the Russian Federation [1]. The strategic goal of the Russian Railways OAO is to achieve a traffic safety level corresponding to the status of a holding that takes a leading position among the world's railways in terms of the safety of the provided infrastructure services, security and reliability of all processes. To achieve this goal is to form a qualitatively new image of the holding by the middle of the next decade. In order to head over to a higher level of development in relations with the state, society, partners and employees of the holding in the field of traffic safety, the following goals have been determined: ensuring people's health and life safety; ensuring a given level of traffic safety that meets international and national requirements; ensuring cargo, rolling stock and infrastructure safety; minimization of the consequences of traffic accidents. Train traffic safety is ensured at all stages of the life cycle of rolling stock, traffic support systems and infrastructure elements. Nevertheless, failures occur and malfunctions can be detected during the operation [2].

Today, great attention is paid to ensuring a high level of traffic safety [1-3] and operational reliability. Transport accidents lead to large technical and material losses. The consequence of transport accidents is goods and equipment damage, destruction of tracks and contact networks,
cessation of train traffic on the site, which leads to large economic and human losses. This risk gave
impetus to the development and implementation of rolling stock control means, namely, the use of
automated diagnostic systems [3].

The rolling stock control system performs such types of control as: control of the axle box unit
temperature and wheel braking, drag control, control of the overall dimensions of cars, control of
wheel defects along the rolling circle, control of the geometric parameters of the wheel, control of the
wheel parameters, control of the parameters of the shock-traction mechanism, control of cars loading
unevenness, control of axle box sliding from the axle neck.

The placement of such control devices on the tracks or approaches to the maintenance points of
freight cars allows, even before the train arrives, to obtain reliable information about the nature of the
arising defect, its location, and the process of its development. All this makes it possible to
significantly improve the quality of maintenance and repair of rolling stock, and, consequently, the
safety of train traffic.

The object of the research is “Multifunctional Technical Means Complex”.

2. The multifunctional system of technical means (henceforth referred as MSTM)
It is designed to control the heating of the axle-box unit while the train is in motion with the formation
of alarm indications with the levels "Alarm 0" (requires no train stop), "Alarm 1" (requires a train stop
at the station) and "Alarm 2" (requires a train stop at the station-to-station block). All devices are
integrated into the automated control system of the rolling stock ACS RS, which allows monitoring
the dynamics of heating of the axle-boxes and, when a predetermined threshold is exceeded,
generating a signal "Alarm 0 (dynamics)". This is especially important at the sections of non-stop train
operation, since Russian Railways OAO has established a procedure for presenting cars, which had
alarm readings with the level "Alarm 0" along the route, for inspection at the maintenance depot [3,4].

As of January 01, 2019, 4802 control points are in operation. 5888 MSTM devices are located at
these points, including 4611 MSTM-02 devices and 197 MSTM-03 devices. The average distance
between the devices in the main and heavy traffic directions is 21.5 km [3].

In 2002 the multifunctional complex of technical means KTSM-02 was adopted. KTSM-02 is
focused on automatic non-contact detection of: brake malfunctions in cars and locomotives, as well as
overheating of axle boxes of wheelsets. Microprocessor-based diagnostic tools allow increasing the
level of traffic safety through the introduction and accurate determination of the technical condition of
the rolling stock In this case, the resource costs for maintenance of the rolling stock by employees are
minimized, the quality of information equipment increases, and the labor supply of the operating staff
increases [4].

The complex for monitoring KTSM-02 of the technical condition of the rolling stock while the
train is in motion allows:
1 to minimize train delays, the need for spare parts associated with the operating costs of repair and
maintenance;
2 to improve the technical condition of the rolling stock and the repair mechanism associated with
failures of expensive scheduled preventive maintenance of rolling stock, from the periodic distraction
of rolling stock from work on mileage and time;
3 to determine the technical condition of the rolling stock, as a result of which there is an increase
in the reduction of resource consumption for maintenance of the rolling stock, the working conditions
of workers are increased, the quality of service and operation is increasing.

The increase in the introduction of microprocessor-based diagnostics allows increasing the level of
traffic safety.

Throughout the railway network, the largest number of failures (66% of the total) is accounted for
by failures of the floor-mounted MSTM camera [5]. As the analysis of the operation of the floor-
mounted equipment has shown, the weakest points of the floor-mounted MSTM camera are: the
receiving capsule, the bolometer, and the sensors [5].
In the area of the floor-mounted cameras, the ballast layer is applied exclusively by hand. When heavy trains are in motion, pressure is exerted on the cameras, the fastening of the rail to the reinforced concrete sleepers weakens, the sleepers shift and clamp the floor cameras, which leads to wear of the shock absorbers, beating against the camera, i.e. mechanical stress occurs, which results in false readings of the hot boxes of the device. Tamping sleepers or installing an anti-theft system in these cases do not lead to the desired result. It is proposed to use metal plates 4 (Figure 2) on reinforced concrete sleepers 2 (Figure 2), used for the installation of insulated joints. One plate is solid; the second one is welded from two plates. To prevent the sleepers from moving, they are fastened in pairs on both sides with plates, by means of standard bolted joints that fasten rails 1 (Figure 2) to sleepers 2 (Figure 2). Installation in pairs of blocks 4 (Figure 1) (6-4 mm) on wooden sleepers 2 (Figure 1), fixed with self-tapping screws (70mm).

**Figure 1.** 1 - rails, 2 - wooden sleepers, 3 - floor-mounted cameras, 4 - wooden blocks.

**Figure 2.** 1 - rails, 2 - reinforced concrete sleepers, 3 - floor-mounted cameras, 4 – metal plates.
3. Conclusion

Train traffic safety is the main condition for the operation of the railway, for the transport of passengers and goods. All organizational and technical measures in railway transport must meet the requirements for safe and uninterrupted train traffic. Traffic safety is ensured by the maintenance of all railway structures, tracks, rolling stock, equipment and mechanisms, signaling and communication devices in constant working order. Of no less importance in ensuring safety is the activities of railway personnel directly involved in the implementation of train traffic (machinists, station attendants, etc.). Not only accurate implementation, but, most importantly, the safety and reliability of the entire transportation process depends on their professional preparedness, experience, ability to quickly navigate and make the right decisions in difficult situations. Automation in railway transport, to some extent, will help to reduce the threshold of violations in the safety of train traffic and, automated enforcement of the technology of work in transport by collecting, processing and analyzing relevant information, both from individual rail transport enterprises and from the transportation management system in general, it is the main purpose of the Multilevel Rail Transport Management System.

While improving the equipment, advanced technologies are being introduced, thereby reducing the number of unreliable operations on the control device. The commissioning of microprocessor-based diagnostic tools makes it possible to increase the level of traffic safety through accurate and modern diagnostics of the condition of the rolling stock. As a result, there is a reduction in resource costs for maintenance of the rolling stock. The quality of information provision and working conditions for workers are also improved.

With the expansion of the use of the multifunctional technical means complex, it is possible to reduce train delays, operating costs for maintenance and repair, and the need for spare parts. Monitoring the technical condition of the rolling stock will make it possible to organize a rolling stock repair and maintenance system based on the actual state of critical components. This will make it possible to dismiss an expensive scheduled preventive maintenance system with periodic distraction of the rolling stock from operation by mileage or time.

The reliability of the device (Figure 1, Figure 2) has been checked for a month. This design protects the cameras from mechanical stress, which is directly related to the safety of train traffic. This construction is used at the Zilovskaya division of signaling and interlocking on the Trans-Baikal railway.

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