System for determining state of continuous welded track

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Abstract. The article considers the main disadvantages of the existing method of examining the lashes of a jointless path, in which a pedestrian bypass of the sections of the canvas and their visual control is performed. A system for monitoring the temperature stresses of jointless rail lashes laid in the path is proposed, which allows monitoring the longitudinal displacement of the track throughout the entire life cycle: from the moment the rails are welded into long-length lashes, including their laying, and throughout further operation. The system makes it possible to monitor compliance with the optimal fixing temperature of rail lashes during their laying, welding and fixing, based on data obtained with the help of sensors, to determine the actual fixing temperature in the lashes of a jointless track; to control the optimal fixing temperature of rail lashes in areas of restoration of their integrity.

1 Introduction

In the construction of high-speed railways, most modern railways use the continuous welded rail. The lack of control over the condition of the welded lashes creates a problem for the safety of train traffic, due to thermal stresses in the rails, a bend in hot weather or a fracture of the rail lash in cold weather may occur. Such deformations can occur when the ambient air temperature is high and because of this, large stresses appear in the lashes of the jointless path, which eventually makes the path unstable to external influences. In order to monitor the current state of the lashes of the jointless track, it is necessary to develop a monitoring system to ensure the safety of train traffic [1-8].

The most progressive and popular design of the upper structure of the track is a jointless track. In the developed countries of the world, in particular in France, Germany, Spain, Japan, China, Russia, great attention is paid to expanding the range of its application and is one of the priorities for researchers and railway transport workers. However, despite the many indisputable advantages over the link, the joinless path has a feature that limits the polygon of its expansion. This is the occurrence of significant longitudinal forces in the rail lashes when the temperature of the rails changes relative to the fixing temperature. If the clamping force of the intermediate rail fasteners is insufficient, the theft of rail lashes may occur. Its standard value should be at least 10 kN. At smaller values, longitudinal movements of rails can occur under the action of rolling stock, in other words, track hijacking. The hijacking of rails leads to a change in their stress-strain state, which can

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cause the ejection of the track when the temperature rises and the rupture of joints when it decreases. The hijacking of the track leads to the displacement and distortion of sleepers, the loss of under-rail gaskets. Elimination of the consequences of rail theft is associated with the performance of complex and time-consuming work on the adjustment of gaps and discharge of temperature stresses in rail lashes. Therefore, in order to further expand the joint-free track landfill, it is necessary to introduce a set of diagnostic tools that allow monitoring the condition of intermediate rail fasteners, improve train safety, stability of the joint-free track and reduce the cost of its current maintenance.

Train speeds are increasing on the railways of the world. In order to switch to high speeds, it is necessary to modernize the existing railway tracks and the entire infrastructure. When the temperature changes, longitudinal forces arise in the rail lashes of the jointless track, which is the main danger in the operation of the jointless tracks. When the temperature of the rail-jointed lashes increases (in relation to the temperature of fixing in them when they are laid in the way), the rail-jointed lashes elongate, and in the pinched state, longitudinal forces arise, which can create a danger of ejection of the track. When the temperature decreases in the rails, forces may occur, which can lead to the rupture of the rail lash due to the cut of the butt bolts, while creating a gap dangerous for train traffic.

From the moment of fixing the rail lashes during laying, constant control (monitoring) should be organized over the force of pressing the sole of the rail to the sleeper and over the longitudinal movements (hijacking) of the rail-free lashes.

Stealing lashes due to the violation of the technology of fastening, wear rubber cushioning strips that directly affect the clamping force applied to the foot rail to the sleeper, by weakening the torque applied bonding, which causes the violation of the established temperature-busy mode of operation and can lead to dangerous concentrations of tensile or compressive stresses.

2 Objects and methods of research

At present, in order to detect the longitudinal displacement of the rail lashes in a timely manner, in accordance with industry regulations, a walking tour of the sections of the track and their visual control is carried out. Visual inspection should be carried out on the control sections (lighthouse sleepers), which are located near the picket post at a distance of 100 m from each other. Longitudinal displacement of rail lashes (hijack) show traces of terminals on the sole of the rails (Fig. 1), the displacement of the pads on the tracks (Fig. 2), loose fit of ballast to the side faces of the sleepers and their bias.
With the current maintenance of the jointless track, it is necessary to eliminate shortcomings in order to ensure proper pressing of the rail to the sleeper and the position of the track in the plan and profile according to regulatory documents [11]. During operation, the control sections of the rail lash are shifted relative to the "beacon" sleepers and, accordingly, it becomes impossible to accurately determine the possible theft of the rail without connecting it [12-17].

Fig. 2. Displacement of the under-rail linings along the sleepers.

Until that time, there were no other ways to control the longitudinal movement of the jointless rail lashes. The main disadvantages of this method is that you need:

- make calculations of the lengthening of the rail lash;
- make marks with chalk or oil paint on the sole of the rail and the lining to monitor the movement;
- paint the sleepers with oil paint (fig. 3);
- constantly make visual observation [18].

Fig. 3. Marking of the control section on the lash and the "beacon" sleeper to control the hijacking of the track for the fasteners.
3 Results and discussion
The system for monitoring the temperature stresses of the rail linkless track has successfully passed laboratory tests (Fig. 5).

Fig. 5. Base station with antenna and solar battery
Thus, the monitoring of the jointed track has developed a test program with the creation of artificial faults on a closed section of the track. In addition, the electronic unit of dome sensors records the strip data, including changes, in accordance with the instruction of the Central Law No. 2022r of 01.10.2009 on the establishment of temporary standards for the operation of a non-jointed track. The monitoring system displays information on the electronic unit of dome sensors retransmitting to the control computer from the electronic unit of dome sensors. An electronic unit of dome sensors is designed to verify the reliability of the work of the electronic unit of dome sensors. The economic feasibility of the proposed development is as follows: only the border色素 mileage of the optimal fixing temperature during forced heating of the whip and scourge will provide an economic effect of about 1 billion sum on the network of JSC "Uzbekistan Railways". The results of the economic analysis of the proposed monitoring system are shown in Figure 6.

4 Conclusion

Fig. 6.
References


