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MICROPROCESSOR-BASED AUTO-LOCKING SYSTEMS AND THE PRINCIPLES OF THEIR OPERATION

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Abstract:

The article discusses the emergence of a new generation of automation and telemechanics tools based on a microprocessor element base, which brought new requirements for determining reliability characteristics and safety indicators. A more reliable element base, the use of diagnostic tools and other measures lead to the fact that the probability of failures in new railway automation devices is less than in traditional relay devices.

Keywords: Microprocessor system, railway automation and telemechanics systems, tone rail circuits, the system of interval regulation of train traffic, alarm, centralization and blocking, auto-lock.

INTRODUCTION

The solution of the strategic task of increasing the efficiency of railway transport, increasing the capacity and carrying capacity of railways is impossible without equipping them with modern and reliable technical means. At the same time, a special role belongs to automation and communication tools. Accounting for only 5% of the total cost of fixed assets, they determine the capacity of railway lines, ensure the automation of the transportation process and the safety of train traffic. The transportation process implemented in railway transport consists of many private technological processes, the main of which is the process of train traffic control. And, as a consequence, all technological processes performed in other railway transport facilities and related to the transportation process can be integrated only on the basis of interval train traffic control systems the system of interval regulation of train traffic. Which, in turn, determines the time and spatial safe interval between trains, the role, significance and effectiveness of railway automation and telemechanics systems railway automation and telemechanics systems.

The new technologies introduced in the the system of interval regulation of train traffic make it possible to increase the safety of the transportation process and the capacity of railway lines and, consequently, to increase the efficiency of the transportation process as a whole due to intensive factors of the development of transport production. New technologies include, in particular, modern systems of railway automation, railway automation and telemechanics systems, made on a new element base. Most of the reaper systems operated on railways include devices made on a relay element base. The current state of railway automation and telemechanics is characterized by the process of intensive creation and implementation of devices implemented using the latest achievements of microelectronics, microprocessor technology, theory of transmission and signal processing. Of these, auto-locking with tonal rail circuits has high reliability, a high return coefficient of the track receiver, high noise immunity and protection from the effects of traction current. In auto-locking with tonal rail chains, rail chains without insulating joints are used. In these rail circuits, a tonal frequency current is used as a signal current. The main advantage of such rail circuits is the absence of insulating joints on the stretch, which significantly reduces the time for their maintenance, provides better conditions for the sewerage of reverse traction current. With such rail circuits, the number of choke transformers is significantly reduced. Also, tonal frequency rail circuits, unlike other types of rail circuits, can work steadily with reduced ballast resistance.

Two types of shopping and entertainment center-3 and shopping and entertainment center-4 rail chains are used (respectively, third and fourth generation tone rail chains). The shopping and entertainment center-3 rail circuits use a signal current of 420 or 480 Hz and have a maximum length of 1000 m. shopping and entertainment center -4 uses a current frequency of 5000, 5500, 4500 Hz, their length is 100-300 m (usually 200 m). Since the length of the auto-locking block section is more than 1000 m, each block section is controlled by several tone rail circuits (usually four). Two shopping and entertainment center-4 with a bypass zone of 15 m are placed at the passing traffic lights, the rest of the block section is controlled by one or two shopping and entertainment center -3 with a bypass zone of 150 m. All equipment of tone rail circuits is placed in relay cabinets of signal points, only matching elements (transformers) and protection elements (arresters) are located at the connection points of the equipment.

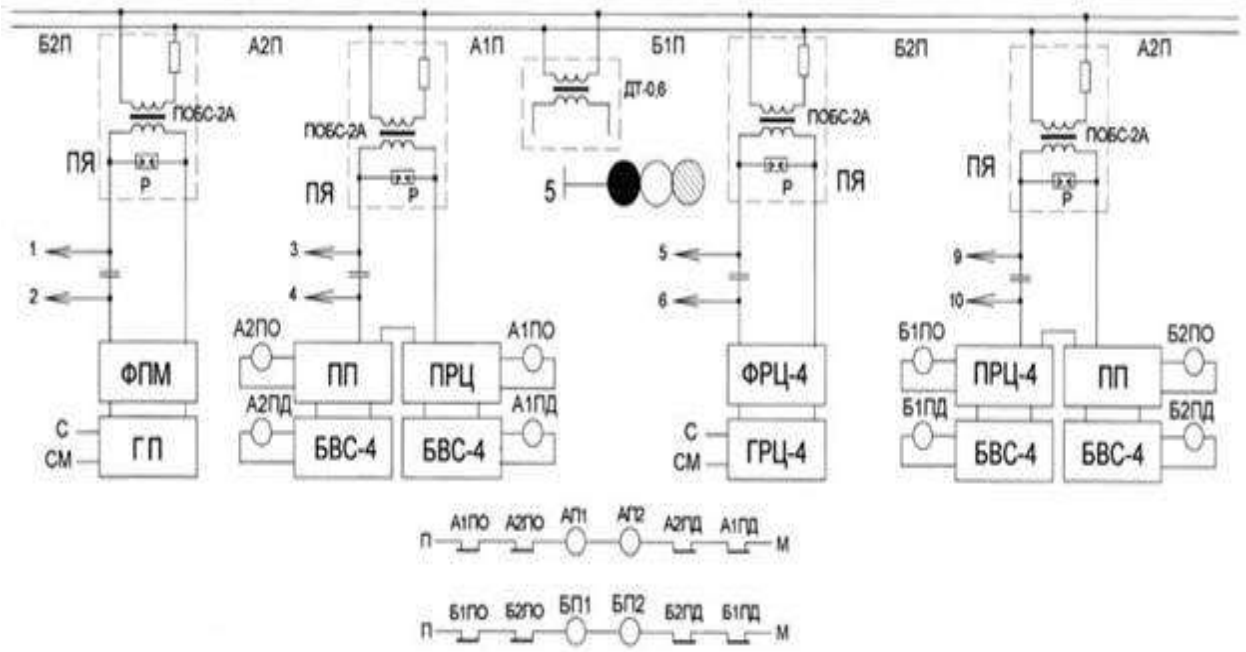

Fig. 1. Tonal frequency rail circuits

The shopping and entertainment center-3 rail circuits are powered by a GP generator (Fig. 1) that generates a signal at a frequency of 420 or 480 Hz, through the filter of the supply end, this signal is fed to a transformer that matches the resistance of the equipment with the resistance of the rail line. The signal from the GP generator in the absence of a train is perceived by two PP receivers placed on both sides of the generator at a distance of no more than 1000 m . At the output of the receiver, the main way relays A2PO and B2PO are switched on. Duplicate relays A2PD and B2PD are connected to the receiver via the BVS-4 interface rectifier unit. The shopping and entertainment center-4 rail circuits are powered by a GRC-4 generator located behind a passing traffic light at a distance of 20 m. A signal with a frequency of 5000 or 4500 Hz is fed into the rail line through the FRC-4 feed filter. Two PRC-4 receivers receive a signal from the line, at the output of which the A1PO and B1PO path relays are switched on. The redundant relays B1PD and A1PD receive power through the interface rectifier unit. The switch-on location of the shopping and entertainment center-3 and shopping and entertainment center-4 receivers is usually combined. When one of the track or backup relays is de-energized, the block section is considered occupied.

On double-track sections, signal current modulation is used to protect against the ingress of signal current from one path to another path. On one path, the signal is modulated with a frequency of 8 Hz, on the other – 12 Hz. Tonal rail circuits are encoded on each block section from several points (1-2, 3-4, 5-6, 9-10) as the train progresses. At the same time, 50 Hz power is supplied to the corresponding points through the contacts of the transmitter relay (not shown in Fig. 1). Choke transformers in tonal auto-locking are used only to equalize the traction current in the rails, for this purpose, one choke transformer is installed at the passing traffic light, it is allowed to connect the supply end of the shopping and entertainment center-4 through this DT. The disadvantages of tonal rail circuits (compared to 25 Hz code rail circuits) include a larger number of equipment and greater cable consumption (especially in a shopping mall with a central location of equipment). Tonal rail circuits with central placement of equipment are considered the most promising now. With this arrangement, the maintenance costs of rail chains are significantly reduced. Tonal rail circuits are also used to control sections of stations. According to the type of element base of the AB system with a shopping mall, it can be divided into systems with relay-contact devices, microelectronic systems and microprocessor systems. Currently, a number of microprocessor systems and devices for controlling train traffic and shunting work are being implemented on the steel highway network. These are dispatch centralization and dispatch control, electrical centralization and auto – locking, semi – automatic locking. These systems are supplemented with new power supply devices, digital equipment of rail circuits, axle counters, multi-digit automatic locomotive signaling (ALS), microprocessor –based (ALS) equipment on the locomotive. Accordingly, most manufacturers of compressed devices stop producing electromechanical relays and switch to a microprocessor element base. This is explained by the following advantages of microprocessor devices.

1. The element base (intermediate transformers, electronic part, output devices) for most devices is railway automation and telemechanics systems almost the same. The difference lies in the software.

2. Due to the identity of the device of kits for various purposes, a high degree of automation of production is achieved with a minimum share of manual labor.

3. Microprocessor devices are organically included in the automated process control system of the electrical part of networks and systems and provide a high degree of informatization of electric power processes. Ultimately, this (over time) should increase the reliability of electric power networks and systems.

4. Microprocessor devices are intelligent systems that have the possibility of improvement by changing the software and using more promising principles of implementation (algorithms) of protection. It is possible to change algorithms and programs during operation.

5. These devices do not require the use of powerful TT and TN, because their consumption through current and voltage circuits is extremely small (units of volts and milliamps).

The widespread introduction of microprocessor devices is constrained by their high cost and the almost absence of microprocessor technology in production. However, this phenomenon is temporary and in the future, microprocessor technology has no alternative railway automation and telemechanics systems, other devices with it will eventually be uncompetitive. In microprocessor systems of electrical centralization, the implementation of logic circuits is based on the use of microprocessor controllers. At the same time, there is a tendency to increase the speed barrier, which in some cases will require an increase in the speed of the track condition monitoring devices. Note here that tonal rail circuits (shopping and entertainment center) are now adopted for the widespread design of new and reconstruction of outdated alarm systems, centralization and blocking. These rail chains are an inertial node that reduces performance. This feature is caused, as is known, by an increase in the noise immunity of track receivers when exposed to pulse interference.

CONCLUSION

To date, research is relevant on the transition to a multiprocessor element base – the construction of a radio frequency center generator and receiver based on programmable logic matrices (Programmable logic integrated circuits) in conjunction with a multiprocessor. A mock-up of the receiver and generator of the frequency radio frequency center was made using majority redundancy. Programmable logic integrated circuits are programmed using the "Spartan" FPGA technology. The processor supports a real-time operating system with developed software or software created as standalone, conducts functional control of programmable logic integrated circuits, collects data, transmits information via any communication channel (Wi-Max is planned), makes a decision. Since programmable logic integrated circuits are a flexible element in terms of programming, a "firmware" for diagnostic monitoring of rail circuit nodes is being developed. In addition, the device solves the problem of overcoming the "hang –up" of the software, as well as an integrated algorithm for self-diagnosis of the system at critical stages of code execution, in general, so that all nodes correspond to the first class of reliability. The basic object for development (Programmable logic integrated circuits) is a universal device, and can be used not only as a generator or receiver of a shopping mall, but also as a multi – channel ADC with galvanic isolation through channels for data collection from any object railway automation and telemechanics systems with a signal frequency of up to 100 MHz Such a device can be successfully applied in automation systems on railway transport. A frequency synthesizer can also be implemented on programmable logic integrated circuits to generate signals in tone rail circuits (shopping and entertainment center) or in converters – inverters of secondary power sources. Microprocessor devices are a truly progressive direction of energy development. The high reliability of microprocessor devices proclaimed by manufacturers does not always correspond to reality. Personnel servicing any microprocessor protection unit should be well aware of all the weaknesses of such devices and skillfully adjust their operation.

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