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ANALYSIS OF THE TECHNOLOGICAL PROCESS OF REPLACEMENT OF DEVICES IN THE RAILWAY AUTOMATION AND TELEMECHANIC SYSTEM

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Annotation: The article analyzes the processes of controlling and replacing railway automation and telemechanics devices. The work that must be done before replacing the devices is described in full sequence. The requirements for all devices have been considered, and mainly the two-sector relay has been fully considered. The dependence of relay contacts on electrical parameters was analyzed and their optimal operation mode was studied. The most basic elements in the inspection and replacement of devices are considered and reviewed step by step: control and cleaning of external parts of the device; opening and cleaning; check the parameters.

Keywords: relay repair operations, local element, road element, device replacement, changeover contacts, mechanical and electrical parameters, repair and technological section.

АНАЛИЗ ТЕХНОЛОГИЧЕСКОГО ПРОЦЕССА ЗАМЕНЫ УСТРОЙСТВ В ЖЕЛЕЗНОДОРОЖНОЙ АВТОМАТИКЕ И ТЕЛЕММЕХАНИКЕ

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Аннотация: В статье анализируются процессы контроля и замены устройств железнодорожной автоматики и телемеханики. Работы, которые необходимо выполнить перед заменой устройств, описаны в полной последовательности. Рассмотрены требования ко всем устройствам, и в основном полностью учтено двухсекторное реле. Проанализирована зависимость контактов реле от электрических параметров и изучен их оптимальный режим работы. Пошагово рассмотрены и рассмотрены самые основные элементы осмотра и замены устройств: контроль и очистка внешних частей устройства; открытие и очистка; проверьте параметры.

Ключевые слова: туристические продукты, национальный стиль, национальность: ремонтные операции реле, локальный элемент, дорожный элемент, замена устройства, перекидные контакты, механические и электрические параметры, ремонтно-технологический участок.

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INTRODUCTION

A workplace for adjusting a two-sector plug-in relay (TSP) is provided with a stand for measurement, a TSP type relay, a single-pedestal table, a megohmmeter, a Ts4312 connected measuring device or a common type, a phase meter or a vector meter, a set of appliances for repair and adjustment, and a contribute technological document.

The beginning relay repair operations are: surface cleaning; opening; cleaning and analysis of the casing; examination and cleaning of the outsides of the cores, coils, rack, and rear of the frame; checking the soldering of the leads of the coils of the track and regional elements; checking the contact jaws of the winding leads and contact blades; analysis and verification of fastening of all parts of the relay with the replacement of faulty plastic parts; inspection of track and regional elements; checking the sector and mechanically related parts; cleaning them [1-2].

Particular attention should be paid to the state of the sector. It is necessary that the sectors have no scratches, shells, burrs, or deformation. To align the sectors on a number of roads, a special device is used, that has a fixed and movable plate mounted on a common frame. The sector is laid between the plates, and the portable plate moves to the fixed one with the force necessary to align the sector.

When checking and repairing contacts, the reliability of riveting and soldering contact and plunge springs, as well as the reliability of pressing carbon contacts in cups and the quality of soldering cups to contact springs, are determined. Carbon contacts are cleaned with velvet files and sandpaper or a sanding file, while silver contacts are cleaned with fine-grained sandpaper or ink gum.

METHODS

It is allowed to use carbon contacts if the contact surface of the contacts protrudes above the cup by at least 1.5 mm, and silver contacts if the wear on them does not exceed 0.2 mm. Contacts that do not meet these positions are substituted.

The coal is determined in the cup by crimps. If this fails to ensure a tidy fixing of the coal, then it is replaced with a new one. After recovering the contacts of the system, the sector is installed in assembly with the axle and contact rods.

The longitudinal and cross backlashes of the sector axis are adapted by rotating the axial screws or picking them up. The longitudinal play of the sector axis in the relay type TSP-12 (TSP-13) should be 0.15-0.25 mm, and the transverse play should be 0.02-0.06 mm.

Having accomplished these performances, the air space between the sector and the poles of the cores is adjusted and calculated. The space, correctly adjusted using the axial screws, must be at least 0.35 mm in the TSP-12 (TSP-13) relay at any sector location. The space is calculated with a feeler gauge.

Then they check the distance between the buffer crimps of the sector and the cores of the magnetic circuits at the extreme situations of the sector and the frames, brought to a stop, which should be at least 3 mm in the TSP type relay at the top position of the sector and at least 1.5 mm at its rear position [3–5].

The contacts of the system are adapted by bending the thrust plates. This arrangement consists of setting the gaps between the changeable and fixed contacts at the ultimate positions of the sector when the swaging of the sector touches the rollers, which must be at least 1.5 mm. Then the force of the contact springs on the thrust springs is adapted by bending the contact and thrust springs at the root while observing the spaces between the contacts. For the front contacts of the TSP-type relay, the compulsion of the contact springs should be 0.15–0.2 N (15–20 Hz), and for the rear contacts, 0.05–0.08 H (5-8 Hz). The joint travel of the contacts must be at least 0.25 mm,

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the gap between the mobile front (rear) contacts at the moment of differentiation of the changeable contact from the rear (front) must be at least 0.8 mm, and the contact tension on the front and rear contacts must be at least 0–2 H (20 Hz). Non-simultaneous closing and opening of contacts is approved for no more than 0.4 mm. The winding friction of the local element (LE) to direct current at a temperature of 20°C for the relay types TSP-12 and TSP-13 should be 510 Ohm ±10%, and the road element (RE) for the relay type TSP-12 should be 55 Ohm ±10% and the relay type TSP-13 should be 75 Ohm ±10%.

After recovery and modification of the relay on the test stand, assess its electrical parameters in this progression. A voltage of 220 V is set on the local element, and voltage is supplied to the road element from the phase moderator, which sets the condition shift angle (162±5°) between the track current and the voltage of the local windings. In this position, the current of the local LE element is evaluated, and the voltage on the road element gradually rises until the front contacts close. The evaluated values are taken as forward-lift voltage and current. Then the voltage is raised until the thrust roller touches the crimped sector. The assessed values are taken as full lift voltage and current. After that, the voltage is gradually reduced until the opening of the front contacts. The measured values are taken as dropout voltage and current. Drop-out voltage and current must be at least 50% of the actual estimated full sector current and voltage rise. The contact resistance of the contacts should be no more than 0.5 ohm without a socket and no more than 0.55 ohm with a socket.

RESULTS AND DISCUSSION

The TSP relay must be assessed for accuracy in a resonant track circuit. At the same time, a voltage of 220 V is set on the LE winding, and a 5 μF capacitor is associated with the RE winding. The relay sector must be stationary or move in the direction of the rear contacts. The calculated voltage on the RE should be no more than 5 V. Relays that meet these conditions are designed for activity in a resonant track circuit. If the sector moves towards the front contacts when a 5 μF capacitor is associated, or if the sector moves towards the rear contacts but the voltage on the RE exceeds 5 V, the magnetic system must be adapted, which is accomplished in this progression [6].

The rod is disjointed from the changeover contacts, the lock nut and the axial squeeze are discharged from the LE side, and the sector is removed. Then, between the poles of the magnetic system, an exploration with a density of 2–2.5 mm is laid, the screws fixing the magnetic system of the LE are detached, and it moves comparable to the RE. For relays whose section moves under the instruction of the front contacts, the LE magnetic system moves under the guidance of the rear contacts. For relays whose section moves in the direction of the rear contacts when the voltage on the RE and the 5 μF capacitor is more than 5 V, the magnetic system is moved in the direction of the front contacts. After performing these operations, the screws are tightened, the examination is isolated, the section is appointed, rods are connected to the transitional contacts, and the mechanical and electrical parameters of the relay and its reliability in the resonant track circuit are checked.

Table 1

Name of works	Routing		
	Relays induction two-element phase-sensitive TSP 12, 13, 13A, 15, 16		
	Periodicity	Performer profession	Executable items
Repair and examination	TSP 13A - 1 time in 3 years TSP 12, 13, 15, 16 - 1 time in 6 years	Electrician Electromechanic Electromechanic-receiver	1…3 4…12 13…16

TSP-type relays are designed for use in phase-sensitive rail circuits.

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Testing and technological equipment, measuring instruments, tools, and materials: Stand for testing the relay TSP with a set of measuring instruments, a 500V megger, a rearrangement index, sets of probes, a metal ruler, a pair of pincers, a magnifying glass, an electric soldering iron, a gramometer, sets of specialized devices, artificial releases, M6 die, socket, and flat wrenches, a set of needle files, files, hammer, awl, sandpaper, compressed air compressor, encounter, solder, plaster, technical liquid, pen, ink, glue, technical flap, label, stamp, sealing mastic, sets of spare parts, tools, and accessories [7-9].

1. External inspection and external cleaning of the relay. Check for the presence of a brand, label, marking of the manufacturer. Report the identified deviations from the established standards to the senior electrician.

Clean the outside of the relay from dust and dirt. Remove traces of oxidation and corrosion from contact knives. Straighten bent knives. Check the condition of the contact springs of the sockets 1-4; they must not be deformed. Check the reliability of the junction of the contact springs with the knives with a 1.3 mm probe; it must enter the contact spring with force. Check the fastening lock: when pulled, the lock rod should come out of the socket without appointment and, when released, return to its original state. If there are malfunctions, remove the rear cover, check the condition of the rod and spring, replace the defective devices, and fasten the cover.

2. Opening the relay. Remove the sealing mass from the heads of the screws that fasten the handle and casing to the frame. Loosen the screws and remove the cover.

3. Inspection and cleaning of the casing, handles, gaskets, check of mounting, coils, plastic parts. Clean the casing internal part, remove the old label of the repair and technological section. Clean the sealing compression from dirt and dust, replace the damaged one. Check the deficiency of mechanical damage (chips, cracks) on the handle and casing. Replace defective elements.

Check the insulating contact blocks and contact rods with bushings and rollers; their surfaces should not have cracks or chips. Replace defective parts, including rods with holes and rollers with worn axles.

Table 2

Parameter	Limit values			
	TSP-12	TSP-13	TSP-13A	TSP-15 TSP-16
Wire diameter, mm coils of local element coils of road element	0,18 0,315	0,18 0,28	0,2 0,28	0,18 0,28
Number of turns: coils of local element coils of road element	5400 2150	5400 2350	4500 2350	5400 2350
Active resistance, Ohm, coils of local element coils of road element	459-561 53,1-64,9 (49,5-60,5)	459-561 71,1-86,9 (67,5-82,5)	297-363 71,1-86,9 (67,5-82,5)	459-561 71,1-86,9
Total resistance of the road element coil, Ohm, at 50Hz at 25Hz	540-660 -	648-792 -	648-792 321-396	648-792 321-396

During an internal inspection of the relay, check the condition of the installation: the installation wires must not have violations of the insulating coating, be flexible, and be neatly laid without tension. Inspect the coils: coils that have damage to the outer insulation, cracks, or chips should be replaced. Check the presence of a label on the coils (indicating the brand and diameter of the wire, the number of turns, and the resistance of the winding); check the fastening of the leads; and check the quality of soldering. Solders should be even and smooth, without traces of rosin; there should not be broken or unsoldered wire strands in the places of soldering; soldering should be varnished. Between the not-insulated parts of the mounting wires of adjacent contacts, there must be visible gaps, excluding the possibility of communication of electrical circuits.

4. Checking the rivets of the track and local elements. The rivets of the cores of the track and local elements should be checked indirectly for the absence of visible gaps between the plates of the magnetic circuit and backlash in the rivets. If, when pressing the rivet with an awl, there is a play between the rivet and the plates of the magnetic circuit or a gap occurs between the plates of the magnetic circuit, the corresponding coil together with the core should be replaced [10-12].

5. Checking the parameters of the relay windings, replacing coils. Prepare the stand for operation in the resistance measurement mode. Measure the active resistance of the relay windings. At a temperature of (20±3)°C, this resistance should correspond to the data given in table 2.

Relay coils whose winding resistance is outside the specified tolerances must be replaced.

CONCLUSION

The impedance of the winding of the road element (RE) of the relay is measured at a frequency of 50 (25) Hz using the voltmeter-ammeter method. With the sector in the actuation position, the milliamperemeter measures the current in the relay path element circuit, and the voltage on the RE winding of the relay is measured with a voltmeter. The value of the impedance of the relay RE winding is determined by dividing the measured voltage value by the current value in the RE circuit.

The process of replacing railway automation and telemechanics devices was analyzed by several methods. These methods take into account the stages of when and how to replace devices and control them. Due to the nature of the devices and their dependencies on other systems, each device must work precisely. Therefore, a solution was found on the analytical basis of how to replace devices before their expiration date and what methods to use when they fail before their expiration date. The main thing is to ensure not only complete system security but also traffic safety by ensuring the complete connection of all systems.

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