

RELAY OPERATION PROCESS

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Key Terms and Phrases

General information, International Union of Railways (UIC) recommendations on two types of relays for railway automation: N-type and C-type relays, basic operational and technical requirements for N-type relays, C-type relays used in creating safety-ensuring circuits, direct current relay, direct current neutral QN1 (England, "Westinghouse" company) relay, neutral K50 relay, neutral type II (Berlin, WSSB company) relay, polarized relay

General Information

Despite the fact that a wide range of problems related to train traffic control are being solved using microelectronic technology, the prospects for the development and application of relay technology remain, since there are a number of problems that are more appropriately solved with the help of relays. This opinion is also confirmed by the ongoing work on creating new relays.

According to the recommendations of the International Union of Railways (UIC), two types of relays are distinguished in railway automation. The first type of relays (called N-type) corresponds to the Class I reliability relays used in our country. These relays satisfy safety requirements even without control. The second type (C-type) relays satisfy safety requirements only when their operation is controlled by an additional circuit.

The following basic operational and technical requirements are imposed on N-type relays: prevention of contact welding (use of carbon-silver materials); reliable release of the armature under the influence of its own weight; additional force through a return spring for release; relay contact service life of at least $2 \cdot 10^6$ switching operations; minimum contact gap of 1.2 mm; minimum contact pressure of 0.245 N (between carbon-silver contacts), 0.196 N between back contacts (silver-silver); the mechanical capability of the relay must reach 10^7 operations (connections).

N-type relays are not used in railway automation in most European countries. In creating safety-ensuring circuits, they use C-type relays. C-type relays have a relatively simpler design and lower cost. However, a control circuit is used to monitor their failure-free operation. For this reason, the requirement to ensure safety through circuits instead of relays with Class 1 reliability used in constructing safe circuits significantly increases the number of relays used. For example, the electric centralization system built on the HMIII-1 relay in our country requires 60-80 relays for one centralized switch. Similar foreign systems require the use of 130 or more C-type relays for one switch.

Companies with world-renowned names are engaged in the creation and production of relays for railways abroad. These include the "WABCO" (PN-type relays) and "Western Electric" (AF, AK-type relays) companies in the USA, Westinghouse (Q-type relays) company in England, "Siemens" (K50 relays), "Standard Elektrik Lorenz" (BB, BS-type relays), WSSB (II and III-

type relays) companies in Germany, "Ericsson" (JRF-type relays) company in Sweden, OKI (WA, WK, WM-type relays) company in Japan, the Beloyanis company (SR50 relays) in Hungary, and others.

Foreign relays differ from the old and current Russian relays used by us in a number of characteristics. Return springs operating under compression and tension are widely used in them.

The relay releases its armature under the influence of resistance forces generated by the return spring, armature weight, and contact spring reactions. Most foreign relays do not have carbon contacts and use cam control in contacts (see Fig. 9.3, g). Cam control allows simultaneous connection and disconnection of contacts, independence of the relay's electrical and mechanical characteristics from contact spring adjustment, and reduction of the effect of contact wear on contact pressure force. It is noteworthy that German and Swedish relays lack triple contacts, which are replaced by four springs (see Fig. 9.3, d). Such a design increases reliability in electrical circuit disconnection since it disconnects from two places simultaneously.

In some foreign relays, instead of flat contact springs, two parallel wire springs made of beryllium with contacts of silver or palladium are used. Such springs maintain their mechanical properties for a much longer period.

As for polarized relays, some countries use relays with magnetic locking that holds the magnetic relay. In them, the neutral relay design is additionally equipped with a permanent magnet. When the relay coil is disconnected from the source, the armature is held in the attracted state under the influence of the permanent magnet's magnetic flux. This implements a memory function. To release the armature, a reverse direction current is passed through the coil. A motor (engine) relay is used as a phase-sensitive relay (similar to the ДСIII relay), in which a two-phase rotor winding short-circuited asynchronous motor is used. The motor controls the contact system. The relay's operating principle is based on the change in the motor rotor's rotation direction depending on the phase of the supply voltage.

Direct Current Relays

The best exemplary relays from foreign companies differ from each other in the design of their electromagnets, contact systems, and electrical dimensions.

The direct current neutral QN1 (England, "Westinghouse" company) relay (Fig. 1) is mounted on a solid base 1, has a coil 2 located in core 3, a U-shaped yoke, a pivoting armature 5 with an antimagnetic pin 4, and a compression return spring 6. The contact system consists of four vertical column support 9 springs. The limiting 8 plates hold the stationary P and O contact springs, which are connected by an upper structure 7 welded to the yoke. It is displaced by a control plate 10 connected to the armature through the moving contact springs. Contact springs are made of phosphor bronze, make-and-break and back contacts are made of silver with graphite filler, and common contacts are made of silver. The relay has a plug connection and is designed for use in circuits with voltages of 12, 24, and 50 V.

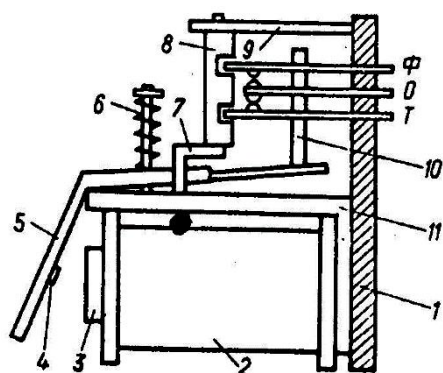
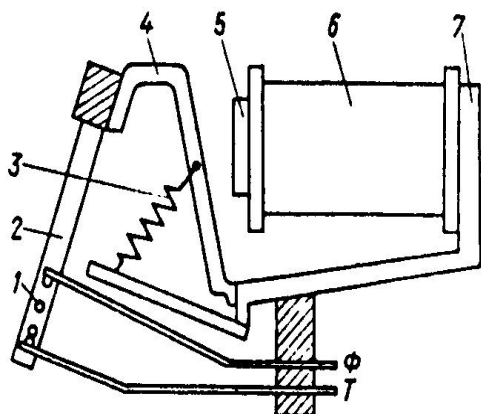


Figure 1. QNI type relay

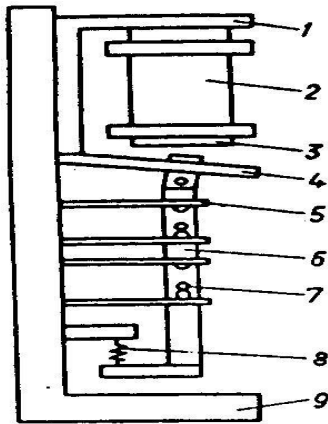
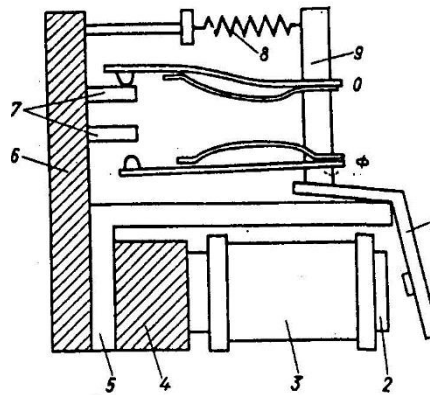
Siemens (Germany) company created the neutral K50 relay (Fig. 2). It consists of coil 6, core 5, yoke 7, armature 4, and tension return spring 3. Contact control is performed by means of contact driving bracket 2 with silver pins 1. Armature return is performed by the influence of spiral spring and contact driving bracket mass. The relay has the convenience of viewing contact positions, is made with normal and reinforced contacts, and is used as a starter in switch electric drive control circuits.

**Figure 2. Relay type K50**

In the neutral type II (Berlin, WSSB company) relay, coil 2 (Fig. 3) is vertically positioned in core 3. The magnetic conductor consists of yoke 1 and contact column 6 with contact pins 7, and armature 4 hinged to the column. The armature is released under the influence of its own weight and the tensile force of compression return spring 8 (5-contact springs, 9-frame).

The relay has two changeover, 11 make, and six break contacts. The transition resistance of two silver contacts does not exceed 0.05Ω . The relay's service life equals 10^6 operations (connect-disconnect).

The same company also produces a small-sized polarized relay with magnetic locking and a highly reliable contact system (Fig. 4). The relay has coil 3, core 2, yoke 5, armature 1, and permanent magnet 4. The armature has contact column 9 installed, to which contact springs and one end of return spring 8 are attached.

*Figure 3. P relay (WSSB))**Figure 4. Polarized relay*

The relay has a series magnetic circuit (see Fig. 1). In the released state, the armature is held by spring 8 force. When current of a certain polarity flows through the coil, i.e., when the magnetic fluxes of the electromagnet and permanent magnet are added, the armature is attracted to the core. When the coil is disconnected from the source, the armature is held by the permanent magnet's influence. When reverse polarity current is connected, the relay releases its armature. The relay has eight contacts, which are formed by the contact of silver attachments fixed on contact springs installed with silver pins 7 on relay plate 6. The relay's capability is 10^7 connections, nominal voltage is 60 V, power consumption is 12 W.

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