NUMERIC AC CODE AUTO-LOCK

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Abstract. *This article gives a brief introduction on numerical transport codes. The relevant equations that are used in these codes are established, and on the basis of these equations, the necessary calculations needed to resolve them are pointed out. Finally, some examples are given, illustrating their application.*

Keywords: *numerical code, automatic block signaling, green and yellow light, train control systems, universal identifier, signaling technologies, code signals.*

Introduction

A "numeric code in transport" typically refers to a series of numbers used to identify a specific item or aspect of a shipment, like a "UN number" for dangerous goods, a "Standard Transportation Commodity Code (STCC)" for the type of freight, or a vehicle registration number for road transport, allowing for efficient tracking and classification within the logistics system.

Key points about numeric codes in transport:

Function:

These codes serve as a universal identifier, enabling quick lookups and accurate data entry when managing shipments, booking cargo space, or coordinating deliveries.

Numerical code automatic blocking is used as a standard system for sections with DC and AC electric traction.

Main Body

This system, used as a standard one in areas with reliable power supply, has the following features: all devices are powered by alternating current; only impulse track circuits with a track relay at the input end of the track circuit are used, while the switching power supply of the track circuits is code signals common to automatic blocking and locomotive signaling; the signal readings of adjacent passing traffic lights are linked using code signals without the use of overhead or cable lines; availability of dispatch control devices for train traffic. In addition to signal current, traction current flows in track circuits, which creates interfering and dangerous effects on the equipment of track circuits. To protect against these interfering influences, signal and traction currents of various frequencies are used. The track relays are switched on through protective filters that allow only the signal current to pass through. However, if the filter

is damaged, the track relay can be excited by the traction current when the track circuit is occupied, which creates a dangerous effect on the operation of the AB. To eliminate the dangerous effect of the path relay, the supply is carried out not by continuous, but by pulsed code signal current, in contrast to continuous traction current.

A message about the signal given by this passing traffic light is transmitted to the previous one, by means of code combinations consisting of AC pulses. Each code combination corresponds to one specific signal of a passing traffic light and differs from the other in the number of pulses in the combination. A green light of a traffic light (code Z) corresponds to a combination of three current pulses, a yellow light (code G) - of two pulses, a red light (code KZh) - of one pulse. Pulses of all combinations end in an interval longer than the intervals between pulses. When receiving the code combinations З and Ж, a green light lights up at a passing traffic light, and a yellow light lights up. When the pulses stop flowing (the section is occupied), a red light lights up at the traffic light.

In the case of numerical code AB, the following shall be installed in the relay cabinet of each pass-through traffic light: pulse relay IP, decoder cell DYa, relay of yellow and green lights, track transmitter CPT, transmitter relay T, fire relay O, emergency relay A and supply transformer PT. The IP track relay is connected to the track circuit through a throttle transformer and a ZBF protective filter. AC pulses of code combinations are created by closing and opening the circuit of the PT track transformer, by the contact of the transmitter relay T, which is controlled by the CPT track transmitter, which generates code signals. Code combinations are generated by signal relays and sent through a choke-transformer to the track circuit from its output end towards the train. At the relay end of the track circuit, the code combination, when the block section is free, is perceived by the impulse track relay IP, and when the rolling stock is moving along the block section, by the ALS locomotive devices [2].

When the green light on the traffic light Z is indicated, the relays З and Ж are excited. This circuit includes a transmitter relay T, which repeats the operation of contact Z (CPT) and, switching its contact in the circuit of the code track transformer PT, transmits the green light code to the track circuit 5P. At traffic light 5, the pulses of the numerical code coming from the track circuit are received by the impulse relay of the PI. Switching its contact, it acts on the decoder DYa, which, by deciphering the signal code Z, creates an excitation circuit of signal relays G and Z. With the help of the front contacts of these relays, the signal circuit of the green light lamps of traffic light 5 is turned on.

In the event of an indication of a yellow light at the traffic light Z, the relay Zh is excited. The front contact of this relay and the rear contact of the relay Z selects the code Ж (CPT) and the relay T. The latter transmits the code Ж to the track circuit 5P. Reception of the code Ж at the traffic light 5 deciphers the DYa and through it, as well as

when receiving the code Z, the signal relays З and Ж are switched on and the green light is lit at the traffic light 5.

When the traffic light 3 of the red light is indicated, the signal relays G and Z are turned off. Through the rear contact of the relay Zh, the code KZh (CPT) is selected and the relay T is turned on. The front contact of the relay Zh at traffic light 5 turns on the yellow light. The path pulse relay acts on the decoder, which consists of three plug blocks: the BS-DA meter unit, the BI-DA exclusion unit and the BK-DA capacitor unit.

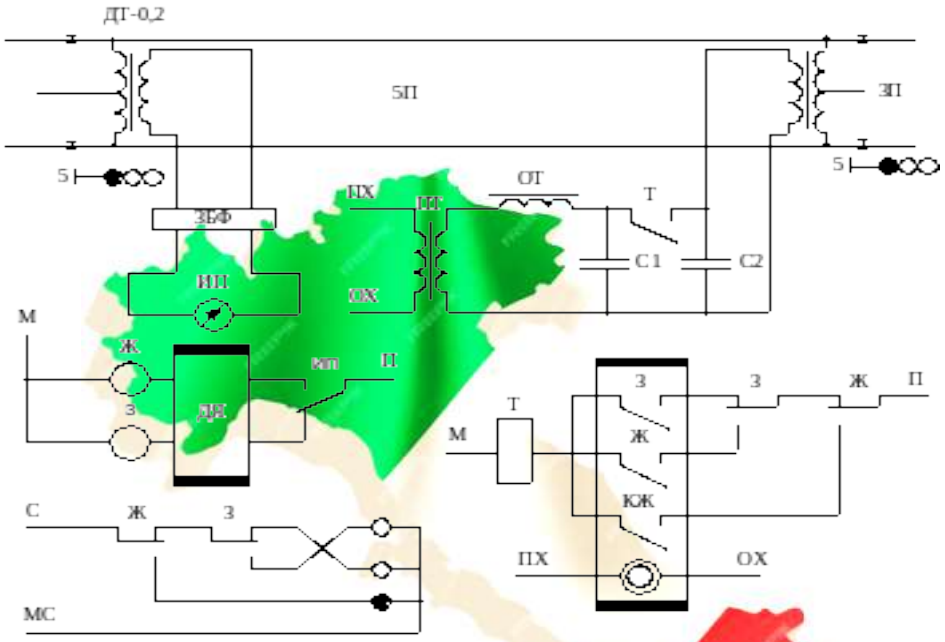

Figure 1.1 – Principle of construction of a code automatic lock with a three-digit alarm, alternating current

Numeric Code Auto-Lock has the following disadvantages:

- Deficiencies in functionality (limited scope of information on traffic conditions;
- Cannot be used in areas with low resistance insulation of the rail line;
- a long and complex procedure for switching to two-way traffic, on 2 track sections;
- shortcomings in reliability indicators (planned and preventive method of maintenance, long duration of restoration devices, relay-contact element base);
- Deficiencies in terms of train traffic safety (high probability of an accident when passing a traffic light with a prohibitive indication In some cases, relays of not the first class of reliability are used, without control of their Shunt loss control is not provided).

- Shortcomings in economic indicators (high costs of service, large consumption of precious metals and electrical materials).

2. Microprocessor-based unified automatic locking system AB-UE

The AB-UE microprocessor-based unified automatic blocking system is designed for: monitoring the state of rail lines and transmitting information between signal points, controlling traffic lights according to traffic safety conditions, generating signals of automatic locomotive signaling systems of the ALS-EN and ALSN numerical codes, transmitting data on the train position on the haul to the station and diagnosing the equipment of automatic blocking signal points.

The AB-UE system can work with track circuits without insulating joints and with insulating joints. The signal point equipment includes a transceiver of signals for monitoring the condition of rail lines (CRL) and protection and coordination devices. Electromagnetic relays are completely excluded from the system. The transceiver provides switching on and monitoring the integrity of the filaments of double-strand traffic lights of two directions.

Signal installations are connected to each other and to stations by track circuits and by one two-wire line circuit. Each transceiver has a built-in modem. Transceivers and personal computers are installed at stations limiting the haul. All transceivers and computers are connected to a network via modems.

Code combinations of the ALS-EN system are selected for each signal installation depending on the length of the block section. If there are temporary speed limits on the haul, more prohibitive code combinations ALS-EN can be set. Transceivers installed at the stations link the AB-UE system with the interlocking schemes. For this purpose, relays for notifying the approach of trains, monitoring the state of the haul and changing the direction of movement are connected to the outputs of the station transceivers.

In the mode of operation with continuous welded track circuits, two track circuits are arranged within each block section. The feeding end of the track circuits is located in the middle of the block section, and the receiving ones are located near the signal circuits

In the AB-UE system, in the mode of operation with track circuits without insulating joints, preliminary activation of coding, codes, ALS is provided.

The signal from the track circuits is transmitted through the protection and matching device to the inputs of the analog-to-digital converters of the transceiver, where it is converted into digital form. All signal processing is performed by digital signal processors. Each signal processor performs filtering and demodulation of CRL signals, averaging their voltages, comparing average voltage values with the threshold, modulating CRL and ALS signals, monitoring power amplifiers, and testing ADCs. The sum of the CRL, ALSN, and ALS-EN signals is fed through a digital-to-analog converter

to the input of the linear power amplifier. The use of a linear power amplifier allows signals to be generated with a limited frequency bandwidth without external filters, which reduces the number of instruments in the relay cabinet. The output voltage of the power amplifier is independent of the mains voltage, which increases the stability of the track circuits.

The technological algorithm of the automatic blocking signal point is implemented on a microcontroller. The microcontroller selects the traffic light reading in accordance with the accepted code combination and the integrity of the traffic light lamp filaments, controls the switching of the filaments of double-strand lamps, generates code combinations of CRL and ALS transmitted along the track circuit to the next signal point, pre-enables coding and changes direction.

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