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TELEMETRIC SYSTEM FOR THE CONTROL OF SIGNAL PARAMETERS OF RAIL CIRCUITS

The characteristics of existing methods of control of time and numerical parameters of codes transmitted in rail circuits are described. The device meant for this purpose is proposed. The principle of its work is considered.

TELEMETRYCZNE SYSTEMY KONTROLOWANIA PARAMETRÓW SYGNAŁU OBWODÓW TOROWYCH

Referat dotyczy próby określenia kodu parametrów prądu obwodów torowych. Jest to potrzebne w celu polepszenia metod i środków utrzymania, związanych ze wzrostem niezawodności automatycznych urządzeń kolejowych. Są to metody pomiaru prądu w przerwie pomiędzy jadącymi pociągami. Zaproponowane urządzenie jest zrealizowane na bazie nowoczesnego mikroprocesora i technik komputerowych.

1. INTRODUCTION

The safety of a railway transport depends on the different factors. One of them is the reliable functioning of the rail circuits.

It is known that the refusals in rail circuits is 15%, and distortion of signals transmitted on rail lines is 7 % from all refusals of automatic block system of ukrainian railway [1]. Thus, It is necessary to increase the reliability of rail circuits for the normal functioning of all railway automatics devices.

Now the measurement apparatures of rail circuit parameters taking place have low exactitude and do not provide sufficient productivity of the control. One of measures providing increase of rail circuits reliability is the perfection of methods and means of diagnosing of their capacity for work.

Modern development level of microprocessor and computer techniques allows us to decide a question about control of parameters of rail circuits and codes of automatic locomotive signaling devices effectively. In this article automatic locomotive signalling code parameters control device on the base of microprocessor have been described.

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2. CHARACTERISTICS OF EXISTING CONTROL METHODS OF CODES PARAMETERS

The parameters of electrical codes of locomotive signaling system in rails have to correspond to the requirements. The value of this current in rails and duration of pulses (intervals) of electrical signals are controlled in the process of exploitation.

Value of a code current on the rail circuit is set norms. After measurements of ballast resistance and with the help of the regulation tables, the current in a rail circuit input has to be not less than 1,2 A at the diesel-locomotive traction, 1,4 A at the electrical traction of an alternating current, 2A - direct current and not more 25A in output in different weather conditions.

There are following measurement methods of current in rails in an interval between driving trains:

- measurement of a continuous current transmitted in rail circuit at the check instead of pulse. The contact of transmitter-relay is shunted by the cross-wire;
- measurement of a current of locomotive signal system in pulses. The input of rail circuit is shunted by the amvoltmeter with the help of the special wire;
- measurement of the locomotive signal system current in the additional winding of the dross-transformer. The ammeter is connected in parallel to this winding without interrupt in supply. In this case the ammeter shunts a rail circuit;
- measurement of the automatic locomotive signal system current with the help of the shunting of a rail circuit by the test shunt. The given method finds a use at the absence of ammeter with low input resistance. The voltage on the shunt is measured and is divided on its resistance (0,06 Ohm). Received value is current of automatic locomotive signal system.

The check of time parameters of codes is involved the regulation of transmitter-relay. The transmitter-relay of a direct current regulates in following way. The time of their switching on and off have to differ no more than on 0,03-0,05s. Also It takes into account, that for d. c. transmitter-relay is characterised shorten pulses. For the transmitter-relay of alternating current the time of switching on and off have not to differ more than 0,01 s. It has the following property: the times of switching operations equal.

For the automated complex evaluation of capacity for work of rail circuits the system "Control" is used widely.

The measuring system "Control" is intended for measurement of a code current and definition of time parameters of a numerical code of automatic locomotive signaling. Also this system can supervise cross of isolating joint, and thus to define length of rail circuits. During measuring trip the duration of the first pulse and first interval and value of current in the input of rail circuit are determined. The measurement of a current is made with the help of receiving coils located under the car as coils of automatic locomotive signaling.

The system "Control" has such demerits:

- detectors of code current have low level of protection from interference created tractive current;
- it can not determine numerical and time parameters of all codes signal;
- it do not allows us to determine phase of current with the sufficient accuracy;
- it do not define spectrum and values of interference for the following analysis and removal of their action;
- it has not function of statistic processing given date;

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- and it can not determine parameters of rail circuits;
- the dislocation of isolating joint is defined with the error of 20-30 m. The full resistance of the circuit used for the definition of cross of isolating joint is depended on the stability of wheel-rail contact and contact in the joint wheel-axis.

3. PROPOSED SYSTEM OF CODE SIGNAL PARAMETERS CONTROL

The ALS code parameters control device is realised on the base of personal computer of IBM PC type [2]. Proposed devices is intended for the carrying out following functions:

- the input and digital transformation of electrical signals;
- saving recorded data in hard disk;
- the creation data base of recorded and calculated data;
- converting of given data to the Word, Excel, Matlab, Mathcad or Text files;
- the calculation of amplitude-frequency and phase-frequency characteristics of the codes and interference with the help of the Fast Fourier Transformation;
- the filtration of tractive current with the help of the special program;
- the definition of asymmetry current value;
- the output recorded signal and calculation data on the monitor and print;
- the check of the conformity of code parameters to the requirements and the reception of recommendations about probability causes their deviation and their removal;
- the probability and statistical processing of measurements result;
- the definition of length and parameters of rail circuit.

The view of window for the analysis and work with the recorded signal is given for example (Fig.1).



Fig.1. Window for the analysis and processing of recorded signal

This device consists of such unit: the interface block, the analog-digital converter, the multiplexes, the generator of tact impulse, the programmed timer, the data and operate registers and the personal computer.

The signal from the ALS receiving coils transmits to the computer by the LPT parallel port. The signal is accorded with the input diapason of analog-digital converter (ADC) with

the help of the special block. The ten-bit ADC is used in devices. The application of ADC, which has lower bit, don't give necessary exactness of measurements and in result high level of errors in signal record. The quantization frequency is 10 mV. This device means to record signals by the value from -5mV to +5mV. And It is possible to increase the input diapason to the $\pm 100mV$ using the interface block.

Two multiplexers are used to connect ACD with the LPT port because ACD has ten-bit data bus and LPT port has eight-bit data bus. So We have six lines in reserve and They can be used at the sixteen-bit ACD.

The programmed timer is used to control work of ADC. It determines the discretization frequency of input signal. It is possible to set discretization frequency to 40kHz. We can change this value determining discretization coefficient at the clipboard input.

The registers of operate and of data are used to set dicretization frequency and control of timer. The operation of given devices is carried out with the help of the programs written on language of a high level Delphi.

The control of ADC readiness is realized through a special input of LPT port causing hardware interrupt. The subprogram of processing of interrupt reads the ADC data bus in the RAM of computer through multiplexers. Then It is done the computer processing of results.

The window of digital transforming of signal is shown in the Fig.2.

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Pause		Record of signal from outputs of filter		
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	-Save of signal		Osciloscope	
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	Size of file: 000000	kByte		inde

Fig.2. Window for the operation of digital signal transforming

This device allows to record a signal from an output of a filter, as it is required with the Instruction to the maintenance of devices of signaling, centralization and block, and from outputs of ALS coils. The measurement has to carry out two times in year. The signal recording from the ALS coils represents a sum of code ALS signals and tractive current with all harmonic components and impulse hindrances arising during work locomotive and electrosupply system. That is why given device allows us to analyse not only time and numerical parameters of ALS codes, but also to evaluate a degree of influence of hindrances on work of automatics systems and to define analytically reasons of their appearance.

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The results of measurement can be shown on the separate window – osciloscope (Fig.3). There is real signal recorded from the receiving coils of automatic locomotive signaling system.



Fig.3. The Osciloscogram and spectr of signal recorded from automatic locomotive signaling coils

4. CONCLUSION

The following conclusion are done:

- ALS code parameters control device build on the base of microprocessor techniques and personal computer is proposed;
- this device is allowed to analyse value of interference arising in the rail circuits in the result of influence of tractive current and other sources and to determine their causes in further;
- so proposed device is multifunction and It can use to take information as in measuring journey as in work regime of locomotive. Also this device can be applied in the carlaboratory which used on the railway of Ukraine for the definition of automatic locomotive signaling codes parameters.

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