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THE POSITION OF DIAGNOSTICS OF INTER-COIL CONNECTIONS OF THE TRACTION MOTOR

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Abstract: *The article considers the position of the technological position of the control of the inter-coil connection of a traction electric motor. The positions of determining the state of the inter-coil connection of the traction electric motor have been developed. The structure of the power supply and its parameters are determined in accordance with the intended diagnostic position, the functional scheme of the power supply; a simplified scheme is given explaining the principle of operation, the required angle of regulation of the converters and their reliability*.

Key words: *power supply, traction electric motor, excitation winding, medium repair, routine repair, capital repair, thyristor, heating current source.*

About 7% of failures of traction electric motors (TEM) are caused by the destruction of inter-coil connections (ICC) [1].

The purpose of this article is to develop the technological position of the control of the ICC TEM.

In accordance with the Rules for the repair of electric machines of electric locomotives and electric trains, TEM must periodically undergo routine repairs (RR-3) at the depot, medium (MR) and capital (CR) repairs at repair plants.

It is proposed to monitor the state of the ICC during the depot repair of RR-3 after disassembly of the TEM.

TEM repairs are carried out in the electric machine shop of the depot. Therefore, the technological position for monitoring the state of the ICC is supposed to be located in the premises of the electric machine shop of the depot on the repair flow of the skeletons Fig.1.

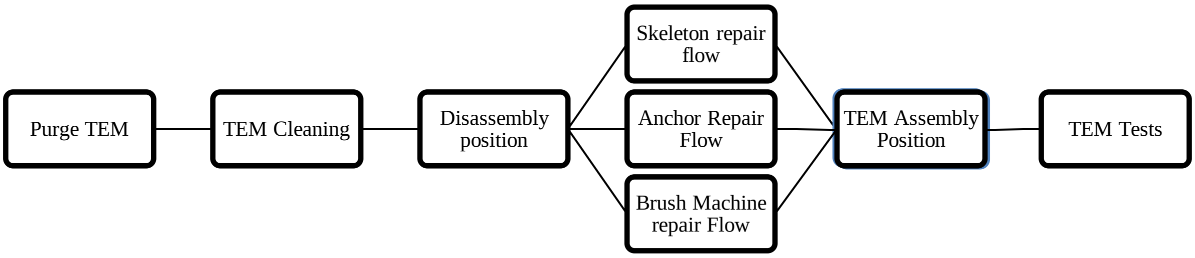

Fig.1. Scheme of dismemberment of TEM repair

The ICC condition is monitored in accordance with the developed algorithm Fig.2.

It is recommended to choose the value of the heating current Ig equal to double the rated current TEM. The time of passing the heating current through the excitation windings (EW) is 10 – 15 min. The place of the ICC defect has increased heating. The place of the defect is indicated by [2].

It is recommended to measure the resistance of S using comparison devices, for example, a DC bridge.

To determine the state of the ICC, it is advisable to use devices that allow assessing their temperature in a non-contact way. To solve this problem, the infrared thermometer "KELVIN" is most suitable: the range of measured temperatures from -30⁰C to 200⁰C or more; the measurement time is 1c.

A thyristor source of heating current (SHC) has been developed for heating the EW Fig.3.

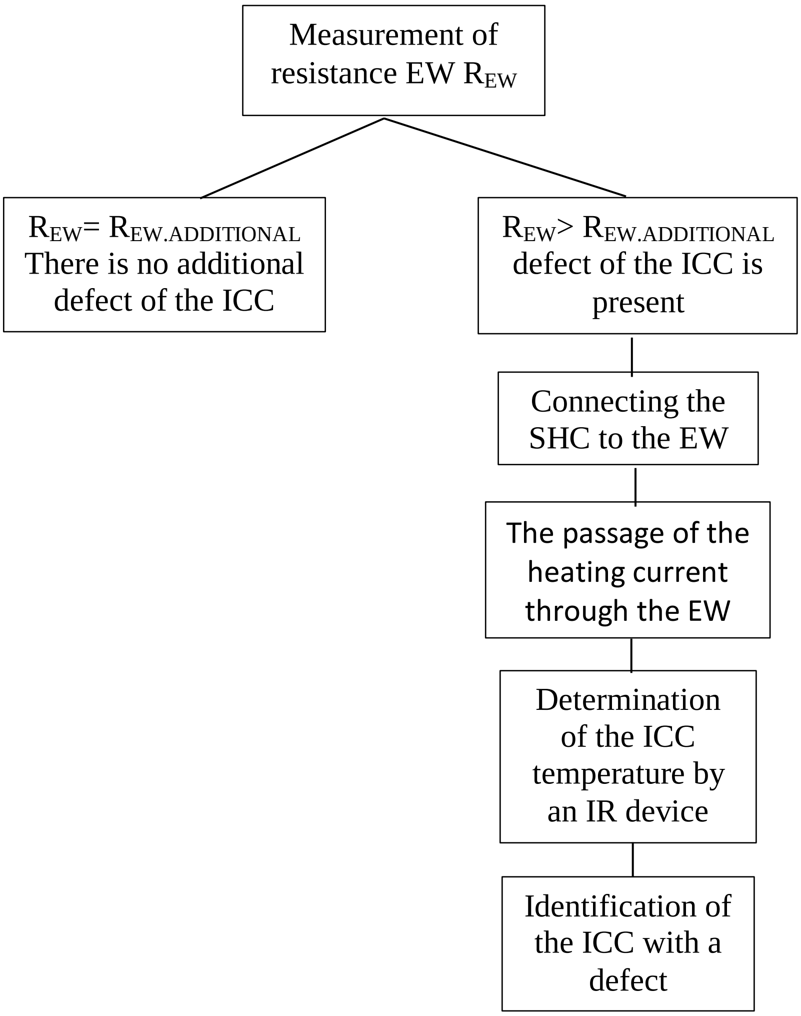

Fig.2. The algorithm of the ICC control method

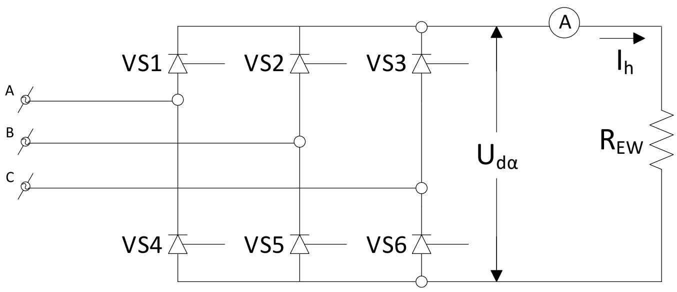

Fig.3. Block diagram of thyristor SHC

The value of the heating current is controlled by an ammeter A. The structure of the SHC is selected and its parameters are determined in accordance with the intended use of DC suburban electric trains (R_{EW} = 0.151 ohms, I_h = 560 A, the input voltage of the SHC is 380/220 V, 50Hz) for monitoring the ICC TEM. In particular, the angle of regulation of the converter is determined:

$$\alpha = arccos\frac{U_{d\alpha}}{K_{sc}U_{ph}} = 80^0$$

where is $U_{d\alpha} = I_h \cdot R_{EW}$ – the rectified voltage at the control angle α, V;

$K_{sc} = 2{,}34$ – numerical coefficient depending on the adopted rectification scheme;

U_{ph} – rated phase voltage of the power supply.

In addition, an assessment of the reliability of SHC was performed. The probability of trouble-free operation of SHC is determined

$$P(t) = e^{-\lambda_{ИГТ} \cdot t}$$

where is: $\lambda_{ИГТ} = \frac{1}{\sum N_i \lambda_i}$ the failure rate of SHC;

N_i – is the number of elements of the *i*-th type;

λ_i – is the failure rate of type *i*-th elements;

t – is the current time.

The average service life up to the 1st failure of the SHC is calculated

$$T = \frac{1}{\lambda_{ИГТ}} = 33000\ \text{h}$$

The results of the calculations are summarized in a table.

№	Name of the PS elements	N_i, pieces	λ_i, 1/h	$N_i \lambda_i$, 1/h
1	Thyristors	6	$0{,}5 \cdot 10^{-6}$	$6 \times 0{,}5 \cdot 10^{-6} = 3 \cdot 10^{-5}$
2	Connections	5	$0{,}002 \cdot 10^{-5}$	$5 \times 0{,}002 \cdot 10^{-5} = 0{,}01 \cdot 10^{-5}$
				$\Sigma N_i \lambda_i = 3{,}01 \cdot 10^{-5}$

The dependence graph is shown in (Fig.4).

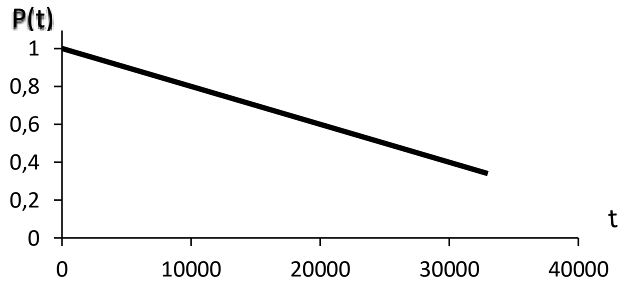

Fig.4. Graph of the dependence of the probability of uptime on time

The implementation of the developed ICC control position will increase the reliability of the TEM and reduce the operating costs of maintaining the electric rolling stock.

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ПОЛОЖЕНИЕ ДИАГНОСТИКИ МЕЖОБМОТОЧНЫХ СОЕДИНЕНИЙ ТЯГОВОГО ДВИГАТЕЛЯ

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Аннотация: В статье рассматривается положение технологического положения управления межобмоточным соединением тягового электродвигателя. Разработаны положения определения состояния межобмоточного соединения тягового электродвигателя. Структура источника питания и его параметры определяются в соответствии с предполагаемым диагностическим положением, функциональной схемой источника питания; приведена упрощенная схема, объясняющая принцип работы, требуемый угол регулирования преобразователей и их надежность.

Ключевые слова: источник питания, тяговый электродвигатель, обмотка возбуждения, средний ремонт, текущий ремонт, капитальный ремонт, тиристор, источник греющего тока.

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