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EQUIPMENT FOR ELECTRIC LOCOMOTIVES CONTROL

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This paper – work presents a installation performend in programmed logic, for control and diagnostic of the 5100 kW Electric Locomotive. The installation simplifies the circuits and markes easier the information transmision to the maintenance personnel.

Key words: programmable automate, diagnostic, the traction conditions, breaking conditions

1. INTRODUCTION

The equipment presented performs the control of the electric locomotives on numerical principle in order to: simplify the control circuits, the transmission of information regarding the dignose to the operating and maintenance personnel, connect all the installations either the processor for a more efficient co-operation.

2. PRESENT STAGE

Presently, the locomotive is controlled either by circuits in cabled logical or by programmed logical.

In case of control by programmed logical, the main element is the programmable automate that contain a central unit with program memory and input/output analogue and numerical interfaces. Based on the stage it is in and on the input modification the automate commands the stage of the out puts and switching to a new stage, if necessary.

The interfaces between the programmable automate and the operating and maintenance personnel consist in display and key-boards placed in the driving posts and the information is transmited via serial connections.

In these locomotives the command controllers in the driving posts that give the displacement directions, the traction or breaking conditions have still an electro-mechanical construction, meaning that closing or opening of contacts in

the command circuit is made depending on the position of the operating handles. During the testing conditions the insulation resistance of the force circuits, auxilliary services and in the train heating circuits can not be measures, in order to detect their decreasing and take necessary actions.

Presently locomotives are equipped with other installations equipped with processor (i.e. the installation for speed measuring with non-volatile memory) and between these installations and the programmable automate there is no data exchange even if this would be very useful, especially when reconstituting the breakdown regime

3. INSTALLATION DESCRIPTION

The installation subject to this invention contains controllers as elements that impose the movement direction and command of the traction or breaking regime.

These controllers use position sensors without contact and transmit information to the programmable automate through serial connections.

The installation has modules for measuring the insulation resistance activated by the programmable automate.

To connect both the numerical display and the insulation resistance measuring module and other equipment the locomotive (the installation for speed measuring with non-volatile memory dimmer driving installation currents protection installation, etc.) the installation has a bidirectional serial bus RS 485 for transmission of the data that characterize the operation of the said installations.

This way, the displays in the board can record into the high capacity memories the evolution in time all the parameters measured in the locomotive.

The installation uses controllers with sensors without contact and make the social transmission of the information witch simplifies the construction, reduces the number of connections, increases the reliability, less effort to operate it and reduces the tiredness of the operating personnel.

Using the resistance measurement modules, the installation measures the insulation resistance of the force circuits, of the auxilliary services and train heating, detecting in due time the defects that might occur.

The installation consists of two programmable automates (one for the force circuits and one for the auxilliary circuits) command controllers (3), (4) and the displays (12), (13) placed in the driving posts and the insulation resistance measuring module (14). The programmable automate of the force circuit contain a central unit (1), serial interfaces for controllers (2) connection, analogue inputs interfaces (5), numerical inputs interfaces (6), numerical outputs interfaces.

The programmable automate of the auxilliary circuits contains a central unit (8), analogue inputs interfaces (9), numerical inputs interfaces (10), numerical outputs interfaces (11).

The central units (1,8), the displays (12), (13), the insulation resistance measuring module (14), the dimmer driving installation (15), currents protection installation (16), the installation for speed measuring with non-volatile memory

(17) that receives data from the electrical energy counter (18) are connected on the 485 serial bus.

The programmable automate of the force circuits contains the central unit (1) equipped with micro-controllers, real time clock, non-volatile memory and serial interfaces, one of them being a bi-directional RS 485. The central unit acces through a parallel bus the controllers serial interfaces (2), the analogue inputs interfaces (5) that measures voltages and currents in the force circuits, the numeric inputs interface (6) connected to the switches, protections of the force circuits, auxilliary contacts of the driven elements and numerical outputs interfaces (7) that command the execution elements (contacts, rectifiers), intermediate relays lamps.

The programmable automate that controles the auxilliary services circuits has a similar structure : central unit (8) analogue inputs interfaces (9), numerical inputs interfaces (10), numerical outputs interfaces (11) that are connected to the similar elements of the auxilliary services circuits.

The controllers (3),(4) placed in the driving posts have a simplified construction. The inverter and controller positions are detected by sensors. A slit that moves when the handle and the controller are driven passes in front of these sensors.

The sensors outputs are connected to a local microcontroller that transmits information refering to the positoin through a serial channel.

This way, the controller has a smaller size, it can be operated using a reduced force it doesn’t require maintenance of the contacts. The wear is reduced . Additionally abnormal operating state or connections break can be detected and the functions of the programmable automate on each position can be easily changed , no modification of any electrical connection being necessary.

The installation has an insulation resistance measuring module. During locomotive testing, by shutting some contactors, the module can be connected in the force circuits, the auxilliary services or train heating circuits and decreasing of the insulation resistance can be detected in due time. Decreasing of the insulation resistance anticipates a resistances breakdown that can cause serious damages and putting out of work of the locomotive.

The connection between the central units (1), (8) and the displays with keyboards (12), (13) in the driving posts is made by a bidirectional bus RS 485.

The central unit (1) has the master role on this bus. Communication is done on 9 bytes in the multiprocessor mode.

The master processor creates windows on the serial in wich the other equipment transmit data. The windows are identified by multiprocessor words with the 9 byte set. Each equipment has an identifier and when it recoqnizes it, the transmitter transmits data that have the byte 9 zero. The lenght in time of the windows is fixed and the slave equipment must end the transmission before the window ends, to enable the master to transmit the next multiprocessor word.

Except for the programmable automates, other equipment that transmit data can be connected to the bus : dimmer driving installation (15), currents protection installation (16), the speed measuring installation with non- volatile memory (17) connected to the electric energy counter (18).

This way, the installations can collect data from each other, for example information concerning the hour.

Date, speed from the speed measuring installation. All the information concerning the normal or faulty operation of the locomotive can be stocked in the high capacity memories of the dispalys (12), (13), enabling the synchronous and correct reconstitution of the operating conditions.

4. CONCLUSIONS

Replacing of cabled logic with programmed logic leads to batreme simplification of the locomotive command circuits with direct conseqnences over the operating and maimtenance activities.

5. BIBLIOGRAPHY

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FIGURE 1