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(54) **SYSTEM FOR REDUNDANT TRANSFER OF INFORMATION FROM A SYSTEM DETECTING FREE STATUS OF TRACK SECTION TO A SIGNALLING SYSTEM, IN PARTICULAR TO A STATION SYSTEM, A LINEAR LOCK SYSTEM, A JUNCTION SIGNALLING SYSTEM AND METHOD OF REDUNDANT TRANSFER OF SUCH INFORMATION**

(57) The invention presents a system for redundant transfer of information from a system detecting free status of track sections to a signalling system, in particular to a station system, a linear lock system, a junction signalling system, in which the system detecting free status of track sections (1) includes n control modules ($Mk_{1,2,...n}$), each of which is equipped with at least one interface system (UI) ensuring connection between the system detecting free status of track sections (S1) and the signalling system (S2). Each of the control modules ($Mk_{1,2,...n}$) uses an interface system (UI) connected with the corresponding processor system (UP) equipped with local memory (MEM) and with a respective communication system (COM). Control modules ($Mk_{1,2,...n}$) are interconnected using a communication bus.

The system according to the invention is characterised in that each of the control modules ($Mk_{1,2,...n}$) is characterised by identical software-hardware design, while processor systems (Up) of individual control modules ($Mk_{1,2,...n}$) are interconnected using the technique of virtual logical peer-to-peer connections.

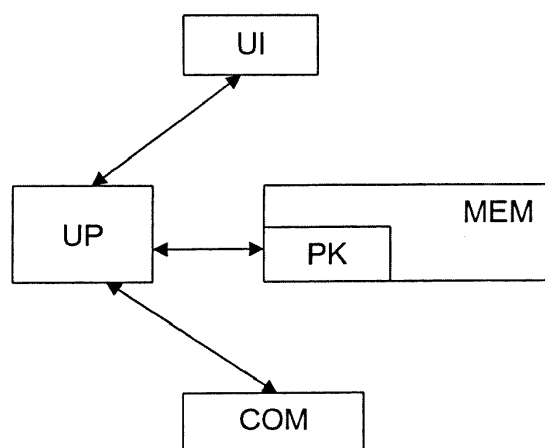


fig. 1

Description

[0001] The invention is related to a system for redundant transfer of information from a system detecting free status of track sections to a signalling system, in particular to a station system, a linear lock system, a junction signalling system and a method of redundant transfer of such information, in particular if high availability of railway system using serial communication is required.

[0002] Known railway safety systems require high levels of availability in order to ensure continuous and uninterrupted railway traffic. These requirements translate into the use of technical solutions using high reliability components, redundancy of selected hardware elements and appropriate maintenance operations.

[0003] There are known solutions oriented at limiting negative impact of telecommunication infrastructure malfunctions, using redundant data transmission networks. These solutions use various redundancy methods, e.g. redundancy on the network level, provided as rings, for example, or redundancy on the level of the communication device provided with redundant network interfaces.

[0004] Especially in the case of particularly high requirements related to availability of control systems, for example in tunnels, underground lines, high speed lines, selective redundancy of equipment is used, as it ensures continuous, correct operation of the system if a single system component is damaged.

[0005] Systems required to provide particularly high availability levels include systems detecting free status of track sections commonly used in railway traffic control systems. Malfunctions of their functioning are directly reflected in perturbation of railway traffic, negatively impacting its continuity and safety.

[0006] The goal of this invention is to develop a solution ensuring high availability of a railway traffic control system.

[0007] System for redundant transfer of information from a system detecting free status of track sections to a signalling system, in particular to a station system, a linear lock system, a junction signalling system in which the system detecting free status of track sections includes n control modules with at least one interface system installed therein, ensuring a connection between the system detecting free status of track sections and the signalling system, wherein each control module uses and interface system connected with the corresponding processor system equipped with local memory and with an appropriate communication system, wherein control modules are interconnected using a communication bus, preferably conforming to the 802.3 Ethernet standard and to standards of safe transmissions, especially using cryptographic techniques, preferably using transmission redundancy techniques, is characterised in that according to the invention, each of the control modules is characterised by identical software and hardware design, while processor systems of the individual control modules are interconnected using virtual logical peer-to-peer connections.

tions.

[0008] Preferably, the communication system within each of the control modules comprises at least one communication controller, preferably installed in a processor system with at least one Ethernet switch system equipped with at least two ports connected to at least two, preferably independent communication buses ensuring connection with other control modules comprising the system detecting free status of track sections.

[0009] The method of redundant information transfer from the system detecting free status of track sections to the signalling system, in particular to a station system, a linear lock system, a junction signalling system is characterised in that according to the invention, the system detecting free status of track section provides information stored in the local memory of the set of n control modules and sent to the signalling system as ordered, individual information signals, wherein each and every single information signal is formed from at least two unit signals obtained from previously identified control modules from the set of n control modules according to a previously specified selection rule for individual control modules. The i th unit signal is obtained by processing information stored in the i th control module, while the j th signal is obtained by processing information stored in the j th control module according to the same processing algorithm implemented in control modules. The j -information is obtained in the j th module by copying the i -information sent from the i th control module during a period no longer than a period previously defined in the system detecting free status of track sections. Thus obtained i th and j th signals are sent in parallel to the signalling system using the appropriate communication system.

[0010] Use of the invention improves safety of railway traffic by ensuring better reliability of information transmission between systems detecting free status of track sections and the signalling system, in particular the station system, the linear lock system or the junction signalling system. The improved reliability is achieved thanks to the resistance of the connected system to communication loss in one of the communication links, for example, because of partial damage to the communication infrastructure, as well as to damage of one of the control modules delivering the free status information to the signalling system. The invention is presented in more detail as an embodiment and in a drawing, in which Fig. 1 presents a schematic diagram of a single control module, Fig. 2 presents a simplified diagram of connections in a peer-to-peer system between 1, 2, ..., n control modules and Fig. 3 presents a diagram of redundant information transfer between i th control module and j th control module.

Example

[0011] The system detecting free status of track sections 1 includes n control modules $Mk_{1,2,...,n}$, in which one interface unit UI is installed, ensuring connection be-

tween the system detecting free status of the tracks S1 and the signalling system S2. Each of the control modules $Mk_{1,2,...,n}$ uses an interface unit UI connected to the corresponding processor unit UP. Each of the processor units is provided with local memory MEM and the corresponding communication system COM. Control modules $Mk_{1,2,...,n}$ are interconnected using a communication bus conforming to the 802.3 Ethernet standard and to safe transmission standards using cryptographic techniques. Each of the control modules $Mk_{1,2,...,n}$ is characterised by identical software-hardware design, while processor systems SP of the individual control modules $Mk_{1,2,...,n}$ are interconnected using virtual logical peer-to-peer connections.

[0012] The communication system COM within each of the control modules $Mk_{1,2,...,n}$ forms a single communication controller built into the processor unit UP with one Ethernet switch system provided with two ports connected to two independent communication buses ensuring connection with other.

[0013] Information transfer from the system detecting free status of track sections S1 to the signalling system S2 of the station system takes place such that the system detecting free status of track sections S1 is provided with information PK stored in the local memory MEM of the set of n control modules $Mk_{1,2,...,n}$ and sent to the signalling system S2 as ordered, individual information signals SYG. Each individual information signal SYG is formed using at least two unit signals SYGi and SYGj obtained from previously identified unit control modules MKi and MKj included in the set of n control modules $Mk_{1,2,...,n}$ according to a previously specified selection rule. The SYGi signal is obtained by processing information stored in the control module MKi and the SYGj signal is obtained by processing information stored in the Mkj module according to an identical processing algorithm implemented in control modules $Mk_{1,2,...,n}$. Here, the j -information is obtained in the Mj module by copying i -information sent from the Mi module during a period not longer than the period previous specified in the system detecting free status of track sections S1. The obtained SYGj signal is sent to the S2 signalling system in parallel to the SYGi signal using the appropriate communication system COM.

Claims

1. System for redundant transfer of information from a system detecting free status of track sections to a signalling system, in particular to a station system, a linear lock system, a junction signalling system, in which the system detecting free status of track sections (1) includes n control modules ($Mk_{1,2,...,n}$) with at least one interface system (UI) installed therein, which ensures connection between the system detecting free status of track sections (S1) and the signalling system (S2), wherein each of the control mod-

ules ($Mk_{1,2,...,n}$) uses an interface system (UI) connected with the corresponding processor system (UP) equipped with local memory (MEM) and with its respective communication system (COM), wherein control modules ($Mk_{1,2,...,n}$) are interconnected using a communication bus, preferably conforming to the 802.3 Ethernet standard and to safe transmission standards, especially using cryptographic techniques, preferably transmission redundancy techniques, **characterised in that** each of the control modules ($Mk_{1,2,...,n}$) is **characterised by** identical software-hardware design, while processor systems (Up) of individual control modules ($Mk_{1,2,...,n}$) are interconnected using the technique of virtual logical peer-to-peer connections.

2. A system according to Claim 1, **characterised in that** the communication system (COM) of each of the control modules ($Mk_{1,2,...,n}$) comprises at least one communication controller, preferably installed in the processor system (UP) with at least one Ethernet switch system provided with at least two ports connected to at least two, preferably independent, communication buses ensuring communication with other control modules ($Mk_{1,2,...,n}$) forming the system detecting free status of track sections (S1).
3. A method of redundant information transfer from the system detecting free status of track sections (S1) to the signalling unit (S2), in particular of a station system, a linear lock system, a junction signalling system, **characterised in that** information (PK) stored in the system detecting free status of track sections (S1), collected in the local memory (MEM) of a set of n control modules ($Mk_{1,2,...,n}$) is sent to the signalling system (S2) as ordered, individual information signals (SYG), wherein each of the information signals (SYG) is formed using at least two unit signals (SYGi) and (SYGj) obtained from control modules (Mki) and (Mkj) out of the set of n control modules ($Mk_{1,2,...,n}$), previously identified according to a previously set selection rule, wherein the unit i -signal (SYGi) is obtained by processing i -information available in the i th control module (Mki), while the unit j -signal (SYGj) is obtained by processing j -information available in the j th control module (Mkj) according to the same processing algorithm implemented in control modules ($Mk_{1,2,...,n}$), wherein the j -information is obtained in the j th module (Mj) during a period not longer than the period of time previously defined in the system detecting free status of track sections (S1), while thus obtained j th signal (SYGj) is sent to the signalling system (s2) in parallel to the unit i th signal (SYGi) using an appropriate communication system (COM).

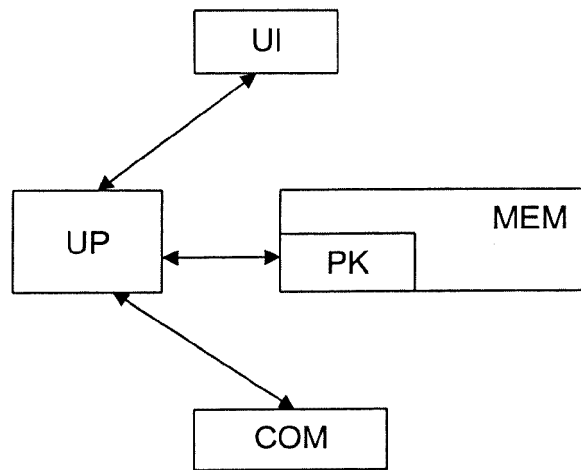


fig. 1

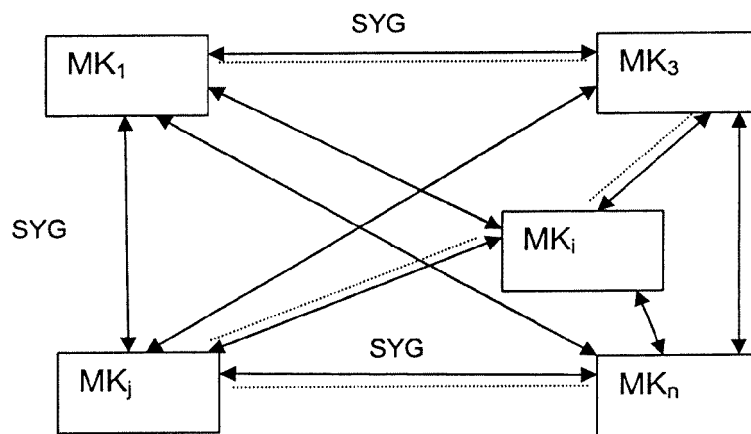


fig. 2

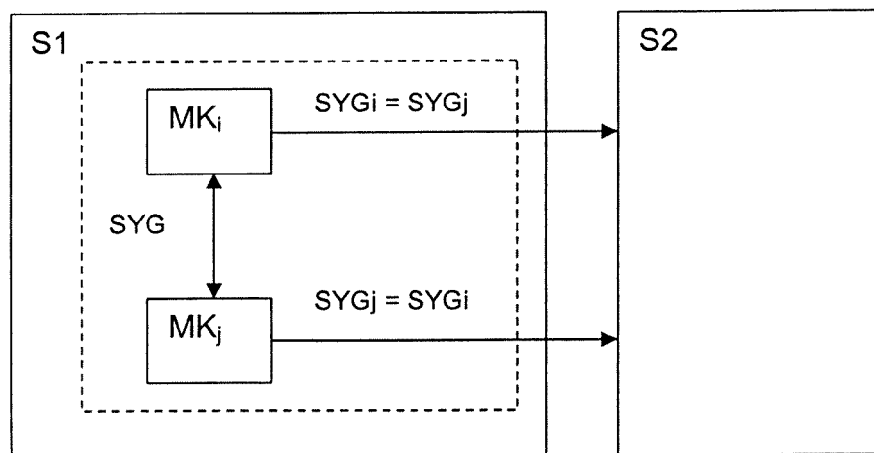


fig. 3



EUROPEAN SEARCH REPORT

 Application Number
 EP 18 46 0040

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2008/069487 A1 (KOREA RAILROAD RES INST [KR]; HWANG JONG GYU [KR]; JO HYUN JEONG [KR];) 12 June 2008 (2008-06-12) * abstract * * paragraph [0016] - paragraph [0017] * * paragraph [0040] - paragraph [0045] * * paragraph [0062] - paragraph [0079]; figures 3,4 *	1-3	INV. H04L12/66
A	DE 25 43 089 B1 (SIEMENS AG) 10 March 1977 (1977-03-10) * the whole document * -----	1-3	
			TECHNICAL FIELDS SEARCHED (IPC)
			H04L B61L
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 22 January 2019	Examiner Von Der Straten, G
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 EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 18 46 0040

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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22-01-2019

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82