(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 716 518 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
09.04.2014 Bulletin 2014/15

(51) Int Cl.:
B61L 27/00 *(2006.01)* *B61L 5/06* *(2006.01)*
B61L 7/08 *(2006.01)*

(21) Application number: **13187292.1**

(22) Date of filing: **03.10.2013**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **04.10.2012 NL 2009572**
14.05.2013 NL 2010803

(71) Applicant: **VolkerRail Nederland BV**
4131 NJ Vianen (NL)

(72) Inventor: **Steentjes, Noël**
4131 NJ Vianen (NL)

(74) Representative: **Assendelft, Jacobus H.W.**
Assendelfts Octrooibureau
Keukenhofdreef 20
2161 AZ Lisse (NL)

(54) **System to monitor the operational functions of moving components of a railway**

(57) System designed to monitor the operational function of a turnout of a railway, which turnout is provided with an electric motor to turnout the turnout, which system comprises a current sensor providing a current measuring signal dependent from the motor current of the electric motor; and a processing unit designed to process the current measuring signal to monitor the operational function of the turnout. The system has a relay sensor providing a relay signal with which the system can determine the position (engaged or disengaged) of a with the turnout associated galvanic turnout relay being part of the driving or controlling of the operation of the turnout, wherein the processing unit is designed to process the relay signal; and the system is designed to monitor, with the current measuring signal and the relay signal, the relation in operational functioning between the electric motor and the said galvanic turnout relay, to determine from it the operational functioning of the turnout.

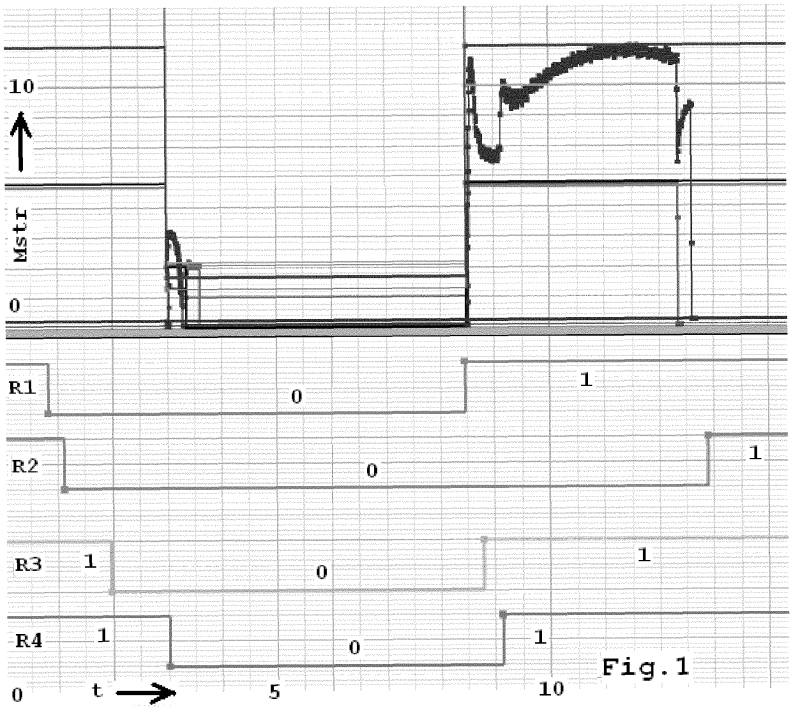

Fig.1

EP 2 716 518 A1

Description

[0001] The invention relates to monitoring the correct functioning of a component, e.g. a turnout of a rail road for transport of people and freight, such as a train or subway track. The system is designed as an aid to safeguard the safety end availability of the railway traffic, by timely detection of a failed component or the oncoming failure of a component.

[0002] EP2441643, NL1012336 and EP1258412 are examples from the prior art. E.g. NL1012336 discloses monitoring the motor current of a turnout actuator. NL1012336 also suggests to monitor the environmental temperature and the wheel load of a passing train.

[0003] The object of the invention is a further improvement of the monitoring system. The invention is particularly for monitoring the operational functions of a railway crossing (road and rail traffic cross) and a turnout. Its application is also possible for different components which are moved mechanically, such as a rail bridge.

[0004] The output of the system can be a signal for ordering a maintenance official or changing the train traffic control to close the relevant track or apply a speed limitation.

[0005] Preferably the system is thus designed to monitor the relation in operational functioning between an actuator (mechanic or motoric element which drives the movement of the component, e.g. an electric motor, e.g. belonging to a turnout actuator or railway crossing actuator) and with it associated galvanic relays, e.g. a so called B-relays, such as one or more of drive relays, control relays, track repeat relays (TPR) and track relays (the TR or so called B2-Vane relay is a frequently applied track relay, the track relay indicates if a train is present at the related track section).

[0006] Turnout malfunctions are e.g.: a piece of ballast between blade and check rail, such that a turnout can not obtain its end position; corroded or frozen contact fingers, such that a turnout can not be moved or does not come into control; altered setting, such that a turnout does not obtain its end position; defective B-relay, such that a turnout can not be driven or does not come into control (in other words does not obtain the controlled end position).

[0007] To be able to identify such turnout failures, the invention proposes to register and monitor one or more of the following parameters: motor current for each turnout actuator; drive for each (group) coupled turnout actuators, turnout or turnout actuator; end position control for each turnout actuator; section occupation (TR and/or TPR); external temperature.

[0008] To be able to indentify a failure of a railway crossing, the invention proposes to register and monitor one or more of the following parameters: motor current (DC) for each crossing operator (the number of crossing operators varies between 2 and roughly 10); buzzer current (DC) of the crossing operator (per channel 2 to 4 buzzer currents are measured simultaneously); lamp currents (AC or DC) of the pole and beam lamps, e.g. if they are not provided with LED (per channel one measures between 2 and 8 lamp currents); lamp currents (AC or DC) of the AG and/or PAG-poles, e.g. if these are not provided with LED (per channel one measures between 2 and 4 lamp currents); battery voltage (DC) of the 12V supply; B-relay for voltage monitoring (POR and/or LG/POPR); B-relay notifications EAR/WAR or NAR/SAR); B-relay crossing (XGNR, TER, TEPR, FXAR and/or XR); 0-6° contacts (0° means a horizontal gate) in the crossing operators, if available; internal temperature and external temperature of the relay cage.

[0009] If the component is provided with an electric motor or equivalent actuator to drive a part of the component, such as is the case with a turnout or railway crossing, the system preferably has a current sensor (galvanic current or a different flow such as hydraulic flow) which outputs a current measuring signal in dependence from the motor current of the electric motor.

[0010] The system preferably has a data or signal processing unit (such as a CPU) and possibly a memory.

[0011] The system preferably has relay sensors with which the system can determine if a relay (particularly so called B-relay or drive relay or control relay) is high (engaged) or low (disengaged). From the current measuring signal the system e.g. determines a current characteristic, or a dependent parameter, such as a mean; maximum; RMS; minimum.

[0012] From one or more of current measuring signal; current characteristic; time elapse (e.g. from occurrence of a predetermined event, e.g. a relay going from (in) high to (out) low (or vice versa) of a relay or start of the electric motor); high (activated) or low (deactivated) of a relay ; the system determines an output, e.g. a failure warning, e.g. a maintenance indication or changes a signal along the railway or gives a warning signal.

[0013] The memory can have a reference value which the system e.g. compares with the actual value, and, at a difference value above a predetermined value, the system gives a failure warning.

[0014] A component, such as a turnout, e.g. for high speeds, can be provided with several actuators, such as turnout operators which are operated in association and e.g. are provided spaced along the length of the blade to provide the desired curvature of the blade during train passage. A railway crossing can be provided with synchronously operated crossing operators. The system can be designed to respond to the signals from such a group of synchronously operated actuators, e.g. the signals from the actuators and the signals from the associated relay.

[0015] Preferably the system is connected to exactly or at least one, two, three, four or more galvanic relays which are associated with a component, to evaluate the data from this relay group.

[0016] For a railway crossing the system is e.g. connected to the notification relay and/or the XR relay.

[0017] The system is preferably provided with a timer

to detect the time elapse, e.g. from the time a predetermined event happens and/or to the time another predetermined event happens.

Examples

[0018] For the attached drawing in the diagram the horizontal axis indicates the time and the vertical axis the analogue signal of the value of the motor current (referred to as Mstr). Fig. 1 shows the system registration of a correct railway crossing cycle.

[0019] The lower part of fig. 1 shows the digital signals associated with the positions of the four B-relay R1 to R4 in time and the upper part the analogue current values of the crossing operators. At the start of the cycle (start is at time 0 seconds) one can see that of the relays R1 - R4 the digital signals change from high (1) to low (0) meaning that a train has moved into the notification. The consequence is that the crossing gates are lowered. The crossing gates descend mainly by their own weight and are only slightly counteracted, thus only a relatively low current is required. After some time (central part of the diagram) the train will have crossed the railway crossing and the digital positions change from low to high. The motor current at raising is relatively high compared to descend. When the gates are in the end position, the complete circuit is inactive again. The inventive system stores the characteristic of fig. 1, or a from it dependent reference, in the memory and compares each time the actual measuring data with it and gives a warning as soon as from this comparison the actual measuring data differ too much.

[0020] Fig. 2 shows the system registration of a correct changeover of a turnout with a single turnout operator.

[0021] The diagram of fig. 2 shows in the lower part the digital signals of the positions of the B-relays responsible for driving and monitoring a switch. There are two relays (WLR and WRR) for driving and two relays for control (WPLR and WPRR). At time '0' relay WPLR is high (1) and relay WPRR low (0). This means that the turnout is in the left end position, thus this relay bears the sign L.

[0022] Far to the left in the diagram of fig. 2 we can just see that relay WRR changes from low (out or in other words not engaged) to high (in or in other words engaged), meaning that the turnout is driven to the right. The consequence is that a current starts flowing (see the upper part of the diagram) and the turnout makes a changeover. Due to this movement the blade leaves its left end position, indicated by relay WPLR which shortly after the start of the current line switches from high to low. After some seconds the turnout is completely changed over and arrives at the right end position, shown by relay WPRR changing from low to high. The drive through relay WRR will now again change from high to low, after which the turnout in the right end position is at rest. Also the relay of the track occupation (shown as Spbz) is illustrated (continuously low). The inventive system will give an alert if within the time elapse one or more of the current measuring value (upper part of the diagram) and the high or low position of the relay WLR, WRR, WPLR and WPRR differs too much from the by fig. 2 specified, time dependent, values for these parameters.

[0023] Fig. 3 shows the system registration of a correct changeover of a turnout with two turnout operators.

[0024] Fig. 3 has great similarity with fig. 2 concerning the drive relay (WLR and WRR) and control relay (WPLR and WPRR). However the diagram of fig. 3 shows a turnout changeover of a turnout having two turnout operators. Both operators have the same driver, but each an own set control relays. The 1 preceding the first set refers to the turnout blades and the 2 refers to the turnout frog. Each operator has its own motor, which is the reason why two current lines are illustrated. The diagram illustrates a left driving, after which the current starts flowing and the turnout blades leave the right end position and after a few seconds arrive at the left end position. After the turnout blades now the current starts flowing through the motor of the frog and these leave the right end position and arrive at the left end position after 3 seconds.

[0025] Fig. 4 shows the system registration of a correct changeover of a turnout with seven turnout operators. StuLi and StuRe mean driving left (EBP) respectively driving right (EBP).

[0026] Fig. 4 shows graphically a turnout changeover of a turnout with seven turnout operators. The lower part illustrates the digital signals corresponding to the positions of the B-relays responsible for the driving and control. The seven turnout operators have the same driving (viz. relay with driving), but each an own set control relays (upper 14 digital lines). While the turnout associated with fig. 3 has merely 1 motor for the turnout blades and 1 motor for the frog, now there are four for the blades and three for the frog.

[0027] The diagram of fig. 4 illustrates that a driving is provided after which a current starts flowing through all four motors of the turnout operators of the turnout blades (synchronous operation). The upper part of the diagram illustrates these current lines (lines mutually cover since the motors run simultaneously). The four sets of control relays show a position change, since all L relays become low and R become high after a few seconds. After some time after the start of movement of the turnout blades the three motors of the frog start moving and also the last three sets control relays change (these are associated with the three frog motors) position. The turnout is now at rest in the left end position.

[0028] Thus the invention relates to, e.g., a system designed to monitor the operating function of a component, e.g. turnout, of a railway for transport of persons and freight, which turnout is provided with an actuator, such as electric motor, to changeover the turnout, which system comprises a current sensor providing a current measuring signal dependent from the to the actuator supplied current, e.g. motor current of the electric motor; and a processing unit designed to process the current meas-

uring signal to monitor the operational function of the turnout. The system has a relay sensor providing a relay signal with which the system can determine (engaged or disengaged) the position of a with the component associated galvanic component relay (e.g. turnout relay) associated with the driving or controlling of the operation of the turnout, wherein the processing unit is designed to process the relay signal. And the system is designed to monitor on the basis of the current measuring signal and the relay signal the association in operations functioning between the electric motor and the said galvanic turnout relay, to determine the operational functioning of the turnout from it.

[0029] This system can further comprise one or more of the following: is designed to determine from the current measuring signal and the relay signal if the component indeed or not reaches its end position; is designed to determine from the current measuring signal and the relay signal a failure alert; is designed to account for time elapse at monitoring from the time a predetermined event being: starting of the electric motor or changing between high and low of the component relay, for which the system is provided with a timer; is provided with a memory having a reference value which the system compares with an actual value based on the parameters current measuring signal, relay signal, and, if applicable, time elapse, such that, if the difference is above a predetermined value, the system provides the failure alert; is connected to at least two relay sensors each associated with a relevant galvanic turnout relay being part of the driving or control of the operation of the component, and the system applies the relay signals of these minimally at least two relay sensors for monitoring; the with the driving or control of the turnout associated galvanic turnout relay, of which the relay sensor is connected to the system for monitoring, is one of: driving relay, control relay and track relay.

[0030] The invention also relates to a method for monitoring the operational function of a component, such as turnout, of a railway to transport persons and freight, which turnout is provided with an actuator, such as electric motor, to changeover of the turnout, wherein a current sensor is applied which provides a current measuring signal which depends from the to the actuator supplied current, e.g. motor current of the electric motor; and a processing unit which is designed to process the current measuring signal to monitor the operational function of the turnout. The method also applies a relay sensor outputting a relay signal with which it is possible to determine the position (engaged or disengaged) of a with the component associated galvanic component relay (e.g. turnout relay) involved in driving or controlling the turnout operation, wherein the processing unit processes the relay signal. And the method monitors the current measuring signal and the relay signal and the relation in operational functioning between the electric motor and the said galvanic turnout relay, to determine from that the operational functioning of the turnout.

[0031] The invention also relates to a method to monitor the operational functions of moving components of a railway, which comprises the process which is carried out during operation of the system as disclosed here.

Claims

1. System designed to monitor the operational function of a turnout of a railway for people transport, which turnout is provided with an electric motor to turnout the turnout, which system comprises a current sensor providing a current measuring signal dependent from the motor current of the electric motor; and a processing unit designed to process the current measuring signal to monitor the operational function of the turnout, **characterised in that**
the system has a relay sensor providing a relay signal with which the system can determine the position (engaged or disengaged) of a with the turnout associated galvanic turnout relay being part of the driving or controlling of the operation of the turnout, wherein the processing unit is designed to process the relay signal;
and the system is designed to monitor, with the current measuring signal and the relay signal, the relation in operational functioning between the electric motor and the said galvanic turnout relay, to determine from it the operational functioning of the turnout.

2. System according to claim 1, designed to determine from the current measuring signal and the relay signal if the turnout indeed or not reaches its end position.

3. System according to claim 1 or 2, designed to determine from the current measuring signal and the relay signal of a failure alert.

4. System according to claim 1, 2 or 3, wherein the system is designed to account for time elapse during monitoring from occurrence of a predetermined event being: starting the electric motor or changing between high and low of the turnout relay, for which the system has a timer.

5. System according to any of claims 1-4, provided with a memory containing a reference value which the system compares with an actual value based on the parameters current measuring signal, relay signal and, if applicable, time elapse, and, if the difference is above a predetermined value, the system provides the failure alert.

6. System according to any of claims 1-5, connected to at least two relay sensors each associated with a relevant galvanic turnout relay which belong to the driving or controlling of the operation of the turnout,

and the system applies the relay signals of these at least two relay sensors for the monitoring.

7. System according to any of claims 1-6, and the with the driving or controlling of the turnout associated galvanic turnout relay, of which the relay sensor is connected to the system for monitoring, is one of: driving relay, control relay en track relay.

8. System according to claim 6, connected to three relay sensors, being the relay sensors of the driving relay, the control relay and the track relay which are associated with the turnout monitored by the system, and the system applies the relay signals of these three relay sensors for monitoring.

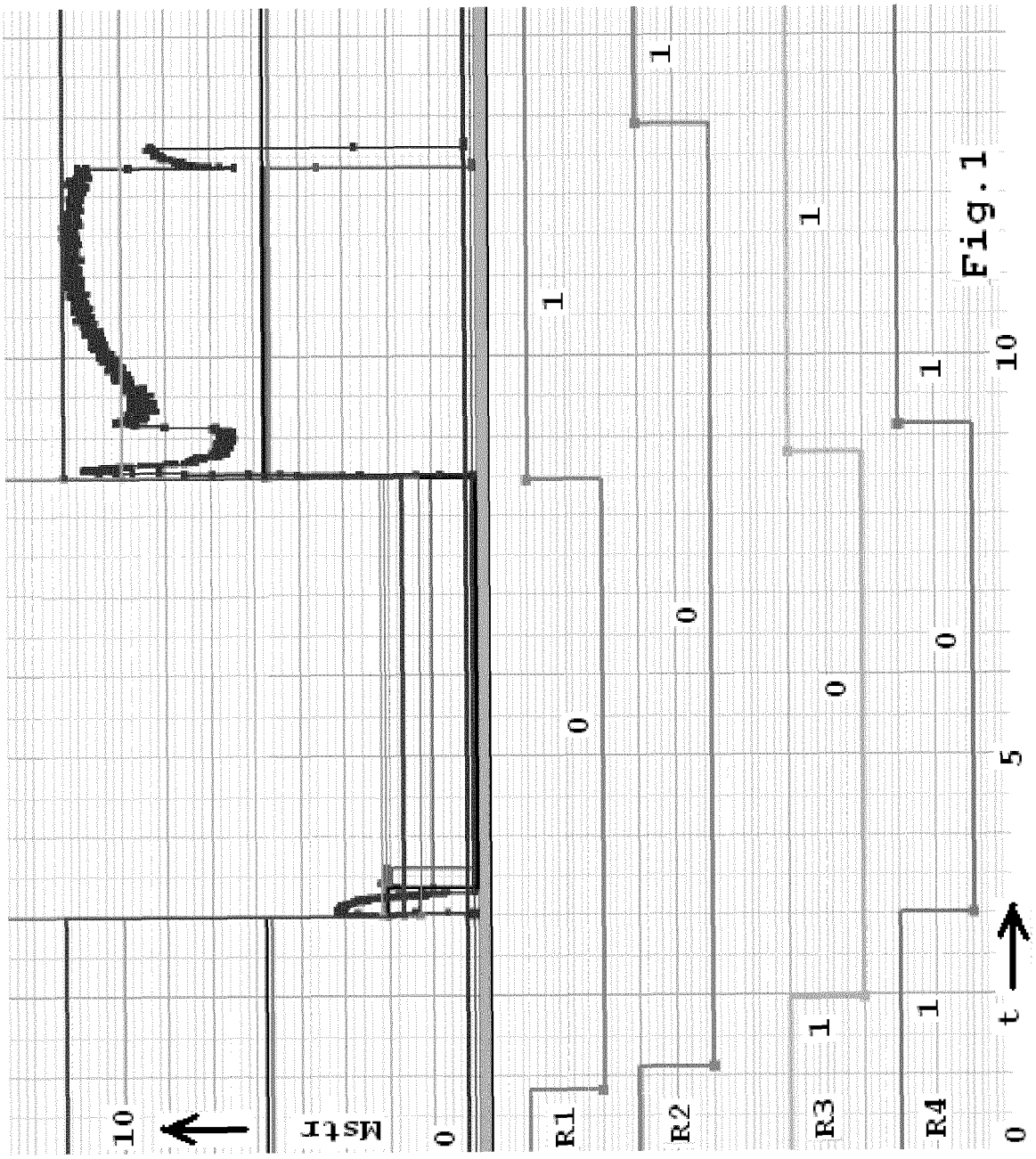

Fig.1

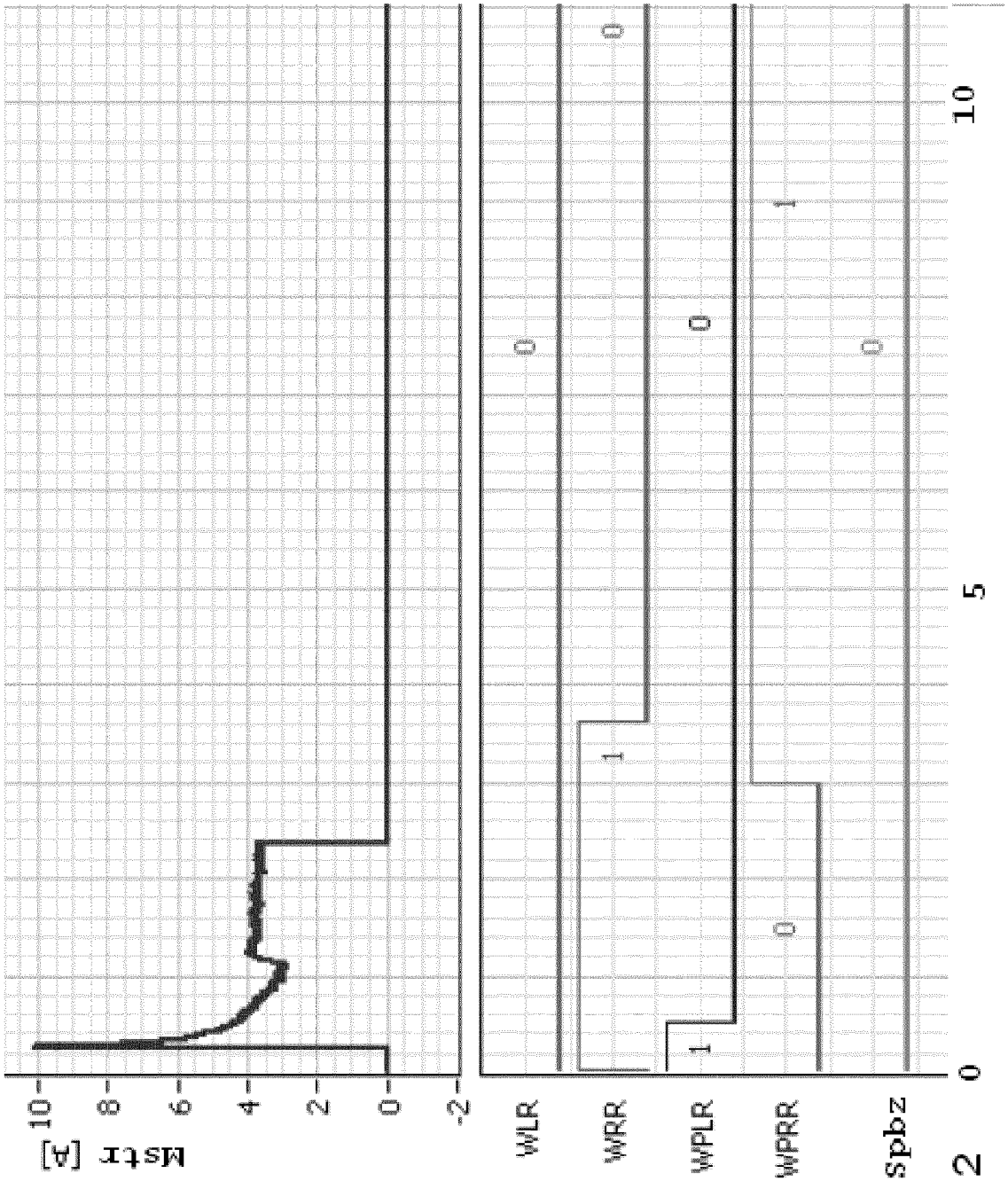

Fig. 2

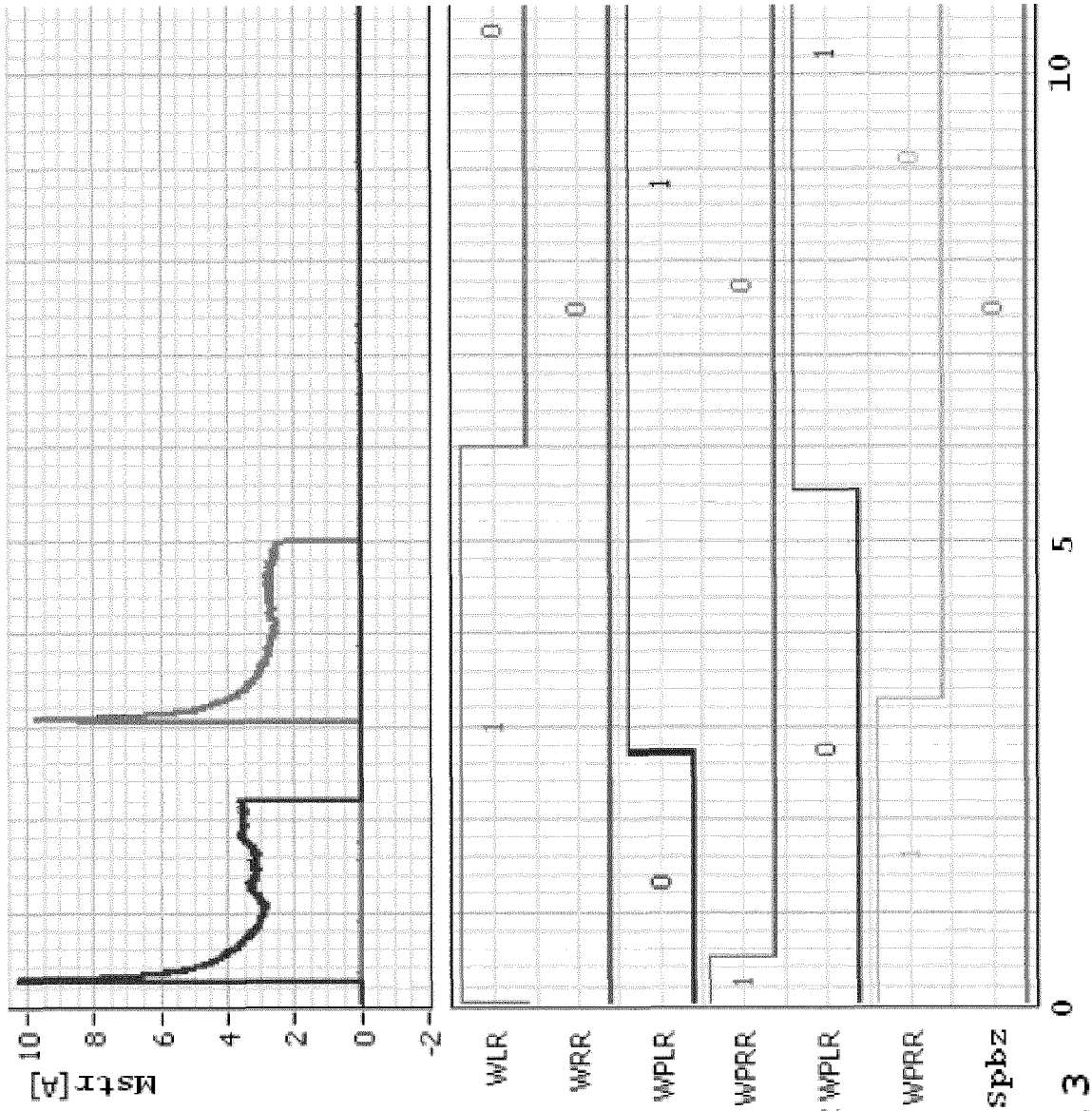
Mstr [A]
10
8
6
4
2
0
-2
WLR
WRR
1 WPLR
1 WPRR
2 WPLR
2 WPRR
spgz
0
1
0
1
0
1
0
1
0
1
0
1
0
5
10

Fig. 3

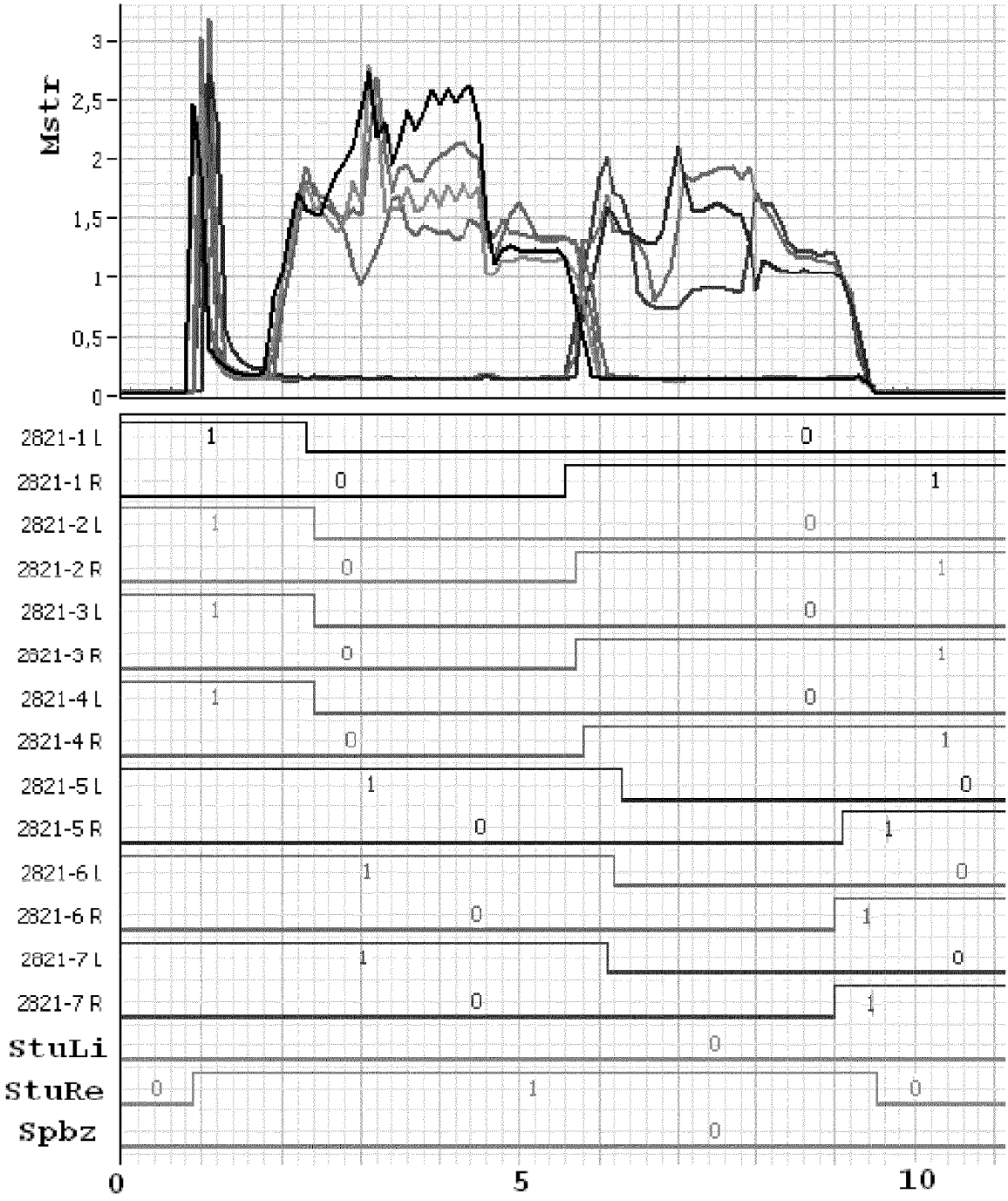
Mstr
3
2,5
2
1,5
1
0,5
0
2821-1 L
2821-1 R
2821-2 L
2821-2 R
2821-3 L
2821-3 R
2821-4 L
2821-4 R
2821-5 L
2821-5 R
2821-6 L
2821-6 R
2821-7 L
2821-7 R
StuLi
StuRe
Spbz
0
5
10

Fig. 4

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 13 18 7292

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 02/090166 A1 (SAFETRAN SYSTEMS CORP [US]; INVENSYS SYS INC [US]; WESTINGHOUSE SIGNAL) 14 November 2002 (2002-11-14) * page 1, line 3 - line 10 * * page 2, line 14 - page 5, line 32 * * page 8, line 15 - page 13, line 4 * * figures 1-4 *	1-8	INV. B61L27/00 ADD. B61L5/06 B61L7/08
X	DE 198 19 162 A1 (SIEMENS AG) 21 January 1999 (1999-01-21) * column 4, line 52 - column 12, line 49; figures 1-7 *	1-8	
A	EP 1 990 252 A1 (ALSTOM FERROVIARIA SPA [IT]) 12 November 2008 (2008-11-12) * paragraphs [0027] - [0045], [0077] - [0105]; figures 2,9 *	1-8	
A	DE 196 06 895 A1 (SIEMENS AG [DE]) 14 August 1997 (1997-08-14) * column 5, line 47 - column 6, line 11; figure 2 *	1-8	TECHNICAL FIELDS SEARCHED (IPC) B61L
A	STRIEBICH M: "Weichendiagnose bei der VAG Nürnberg", SIGNAL + DRAHT, TELZLAFF VERLAG GMBH. DARMSTADT, DE, vol. 104, no. 4, 1 April 2012 (2012-04-01), pages 22-26, XP001573570, ISSN: 0037-4997 * the whole document *	1-8	

-/--

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 January 2014	Massalski, Matthias

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

1

EPO FORM 1503 03.82 (P04C01)

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 13 18 7292

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	KÖRKEMEIER H ET AL: "Weichendiagnose Switchguard Sidis W compact", SIGNAL + DRAHT, TELZLAFF VERLAG GMBH. DARMSTADT, DE, vol. 103, no. 4, 1 April 2011 (2011-04-01) , pages 6-10, XP001560516, ISSN: 0037-4997 * page 24, paragraph 3 - page 26, paragraph 5 * -----	1-8	

TECHNICAL FIELDS SEARCHED (IPC)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 January 2014	Massalski, Matthias

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

1 EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 18 7292

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

22-01-2014

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 02090166 A1	14-11-2002	EP 1390246 A1	25-02-2004
		GB 2392987 A	17-03-2004
		US 2004167686 A1	26-08-2004
		WO 02090166 A1	14-11-2002
DE 19819162 A1	21-01-1999	AT 409362 B	25-07-2002
		CH 693709 A5	31-12-2003
		DE 19819162 A1	21-01-1999
EP 1990252 A1	12-11-2008	AT 449717 T	15-12-2009
		EP 1990252 A1	12-11-2008
		ES 2337202 T3	21-04-2010
		MA 30009 B1	01-12-2008
DE 19606895 A1	14-08-1997	CN 1174146 A	25-02-1998
		DE 19606895 A1	14-08-1997
		RU 2194645 C2	20-12-2002

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 2441643 A **[0002]**
- NL 1012336 **[0002]**
- EP 1258412 A **[0002]**