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(54) **DETECTION DEVICE FOR A SHORT CIRCUIT LINK TO BE APPLIED TO A RAILWAY SECTION**

DETEKTIERGERÄT FÜR EINE KURZSCHLUSSVERBINDUNG FÜR EINEN GLEISABSCHNITT

APPAREILLE DE DETEKTION POUR UNE CONNECTION COURT-CIRCUIT POUR UN SEGMENT FERROVIAIRE

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(56) References cited:
NL-A- 6 905 037 **US-A- 3 299 424**

- **PATENT ABSTRACTS OF JAPAN vol. 018, no. 620 (M-1711), 25 November 1994 & JP,A,06 239236 (SANKOOSHIYA:KK), 30 August 1994, cited in the application**
- **PATENT ABSTRACTS OF JAPAN vol. 016, no. 094 (M-1219), 9 March 1992 & JP,A,03 273970 (DAIDO SIGNAL CO LTD), 5 December 1991,**

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Description

[0001] The invention relates to a detection device for a short circuit link to be applied between or across the rails of a section of railway track, comprising a source of electrical energy and a monitoring device connected to the rails for measuring and monitoring the short circuit resistance caused by the short circuit link.

[0002] The protection of a network of railways by automatic signalling of the presence of trains is generally known. For this purpose the tracks of the network are divided into electrically insulated sections, which are connected to the so-called track circuiting loop, by which it can be established if there is a train on this section. This track circuiting loop consists of a source of alternating current connected to the rails at one end of the section and a relay (the so-called track circuit relay) connected to the rails at the other end of the section. When there is a train on the section the alternating current source is short circuited through the train axles, so that less current flows to the relay and thus it drops out. The signal allowing access to this section will go to red and prevent train movements.

[0003] Whenever work is to be carried out on a section it is usual to place a short circuit link between both rails, which simulates the presence of a train on this section, so that the track circuit relay drops out.

[0004] The protection during work described above has, however, the disadvantage that, using a test procedure, a check has to be made that the track circuit relay actually has dropped out. This means, in practice, that it is necessary first to walk to the signal to make certain that the signal has been brought to danger by the connection of the short circuit link.

[0005] It is known from Patent Abstracts of Japan, vol. 018, no. 620, M-1711, 25 November 1994, JP-A-6,239,236 to use a rail short circuit device for checking the connecting condition between the right and left rails of a railway track and a short circuit member or link. This known device comprises a signal transmitting circuit and a signal detecting circuit connected to the right and left rails respectively. It is detected whether the signal from the signal transmitting circuit is received by the signal detecting circuit or not. This is only a coarse criterion. It is possible that for some reason the short circuit resistance may change and become so high that the track circuit relay again closes, meaning that the area protected for work is again accessible to trains. Such a dangerous situation cannot be detected by the above known rail short circuit device.

[0006] The object of the invention is to avoid the disadvantages described above and improve safety during work on the track.

[0007] This object is achieved according to the invention by providing a detection device including the features of claim 1.

[0008] Thus, the electrical energy source is an alternating current source and the monitoring device comprises a resonant circuit and an evaluation device for the evaluation of the resonance produced in the resonant circuit.

[0009] This system itself can indicate that the short circuit resistance meets the requirements imposed and can provide a local signal of this to the person applying the short circuit. There is a local continuous signal, so that it is not necessary to walk regularly to the signal to check that the signal is at danger, which could easily be forgotten when busy with the work. Safety is thus improved considerably and there is not complete dependence on test protocols.

[0010] Moreover, the source of electrical energy provides alternating current, which works together with a resonant circuit in the monitoring device; this allows very low short circuit resistances to be measured reliably. These measurement results are fed to an evaluation device for the evaluation of the resonance produced by the resonant circuit. Moreover, by using a resonant circuit it is always observed when this circuit, across which it is measured, is defective. For, both a short circuit and an interruption will be detected.

[0011] A reliable choice for the frequency of the alternating current source can be made between 15 and 25 kHz. This frequency is preferably 17 kHz.

[0012] In accordance with the invention the resonant circuit comprises an inductance and a capacitor in series and is connected at one end to an output terminal of the alternating current source, the other output of which is connected to one rail. The other end of the resonant circuit is connected to the other rail. The inductance is connected to a comparator for the comparison of the inductance output signal with a reference signal.

[0013] To improve the reliability of the short circuit resistance measurement the level of the resonant voltage across the inductance is measured, for which the inductance is preferably connected to the comparator through an RMS converter. Thereby an additional reliability is achieved by using an extra selection criterion, i.e. the energy contents. The reliability of the measurement is improved even more by means of a band-pass filter, connected between the inductance and the RMS converter, which filters out interfering frequencies. In a further advantageous version of the invention a pulse generator is provided to control the intermittent switching of the series connection of the alternating current source and the resonant circuit formed by the inductance and capacitor onto the rails, when the comparator is connected to a pulse decoder.

[0014] The intermittent operation not only saves energy, but by using the pulse generator produces measurements at regular intervals. This frequency can also be used as an additional safety criterion. Moreover, by using the intermittent operation the measurement is insensitive for EM interferences.

[0015] For local signalling the detection equipment is also connected to a signalling device that can, if required, provide an external signal.

[0016] The invention will be explained more fully below making use of the drawings.

[0017] The drawings show:

Fig. 1 - a part of the track of a railway network;
Fig. 2 - a preferred version of the detection device according to the invention.

[0018] The part of the track shown in Fig. 1 is divided into sections electrically insulated from each other, of which only sections a, b and c are shown in Fig. 1. Fig. 1 illustrates the track circuit for section b only, this track circuit consists of an alternating current source W1 whose output terminals are connected at one end of section b to rails S1 and S2 respectively. A track circuit relay R1 is connected to these rails S1 and S2 at the other end of this section. When there is a train or other vehicle on this section b, the alternating current source W1 is short-circuited through its wheels and axles, so that relay R drops out as the criterion for the presence of a train or other vehicle on the section in question. This criterion is passed to the signalling equipment to show the section at danger, with the protection of this section also being passed to the traffic controller.

[0019] When work has to be carried out on section b, this section has to be made safe or protected reliably. This protection is achieved, by simulating the presence of a train on the section, for which a short circuit link KL is placed across the rails S1 and S2.

[0020] Because of this, a short circuit link will also cause the relay to drop out or open and the section will be shown as occupied. Train detection is so adjusted that with a short circuit resistance of, for example, 0.3 Ohms the associated track circuit relay must drop out. To be certain that connecting a short circuit link has caused the track circuit relay to drop out the conditions required must, thus, be met. A track can be short-circuited in the following ways.

- Short circuit lance. The short circuit lance, in its simplest form, consists of a metal rod whose ends make contact with the rails S1 and S2 with the lowest possible transition resistance by, for example, penetration of the corrosion layer of the rails. Until now a test procedure has still had to be used to check that the track circuit relay has actually dropped out. A test procedure can, for example, include walking regularly to the signal and checking that the signal is at danger.
- Short-circuiting cable with magnets. Such a cable is used, for example, by drivers when they observe that an unsafe situation exists on another track. This method is less reliable.

[0021] Only when the first method is used does the track remain accessible to any works trains.

[0022] The invention provides a self-signalling short circuit link, which enables continuous, reliable, local signalling that the conditions for short circuit resistance are being met.

[0023] The preferred version of a circuit of a short circuit lance is shown in Fig. 2.

[0024] Fig. 2 shows a part of a section b with the rails S1 and S2. Between the rails S1 and S2 a short circuit lance KL is fitted. The detection device DT associated with the short circuit lance KL is connected to the rails S1 and S2. While a short circuit lance is shown in the version illustrated, the detection device is also suitable for a short-circuiting cable with rail clamps. This method is used when a short circuit lance cannot be used, as for example, at points systems. It is also possible to check if a stationary (works) train, for example a fitting vehicle, produces an adequate short circuit. In addition, adequate short-circuiting by a short-circuiting cable with magnets can also be checked.

[0025] The detection device DT has an electrical energy source providing alternating current connected by one terminal to the rail S1. This alternating current source W2 places a nearly constant alternating voltage on the rails S1 and S2.

[0026] Measurements have shown voltages of various amplitudes and with frequencies up to 5 kHz on the track. OTC sections are also used for protection, using a voltage with a frequency of 10 kHz. Tramways also use frequencies of from 9.5 to 14.5 kHz for train detection.
Thus, the measurement frequency must be outside these ranges. The frequency of the alternating current source W2 has therefore been selected as higher than 15 kHz. It is advantageous to select a frequency below 25 kHz for the alternating current source W2, to avoid high frequency problems caused by self inductances and capacities in the system. Seventeen kHz is an exceptionally suitable frequency, it is relatively low and does not occur in the track. Moreover, there are no frequencies in the track that have 17 kHz as a higher harmonic. At the same time there is some tolerance around 17 kHz, this allows standard components to be used.

[0027] The other output terminal of the alternating current source W2 is connected to the other rail S2 through a resonant circuit, this consists of the inductance L and the capacitor C. By using this resonant circuit very low short circuit resistances can be measured. Whenever there is a proper short circuit there will be an increased voltage across the inductance in the LC circuit. The voltage across the inductance L will be passed to a band-pass filter B to filter out frequencies that are not relevant and cause interference.

[0028] The level of the output voltage from the band-pass filter B can be measured and compared with a reference value that has been previously set to correspond to a short circuit that meets the requirements imposed.

[0029] It is certainly preferable to base the comparison on the resonated voltage, since this will result in a measurement and comparison of greater accuracy and reliability. For this reason the output of the band-pass

filter B is connected to an RMS converter RMSC, this generates the effective value of the output voltage from the band-pass filter B. The RMS converter output voltage is fed to the comparator CO for comparison with a reference signal REF. When the short circuit meets the applicable conditions, the comparator input signal CO will be greater than the reference signal applied to the comparator. A signal will then appear at the comparator output that indicates a safeguarded situation.

[0030] A switch SW is inserted in the connection between the LC circuit and the rail S2, this is controlled by a pulse generator that is not shown. By means of this switch SW the measurement is performed intermittently. Two measurements per second is a suitable choice. Since the measurement is carried out twice a second the adequacy of the short circuit will also be determined twice a second. If this is the case the pulse detector PD connected to the comparator CO gives a safe signal to the signalling device SJ. The pulse detector will be operated synchronously with the switch SW.

[0031] The pulsed detection measurement is described below.

[0032] The measurement circuit consisting of the capacitor C and the inductance L is brought into resonance, this causes an increase in the voltage across the inductance. The level of the voltage increase is a measure of the short circuit value. The voltage across the inductance is measured. It is applied to the input of a 17 kHz band-pass filter, this filters out the 17 kHz signal. Thus, only signals at a frequency of 17 kHz can appear at the output of the band-pass filter.

[0033] The alternating voltage occurring at the band-pass filter outlet is converted to its RMS value by the RMS converter RMSC. This converter determines the energy content of the 17 kHz voltage appearing across the inductance. The signal from the RMS converter is a direct current voltage whose level corresponds to the actual effective value of the alternating voltage of 17 kHz voltage. Interfering voltages with a frequency of 17 kHz will be reduced to a very low level and later rejected. The RMS converter output signal will also be alternated with the 2 Hz of the pulsed measurement.

[0034] The RMS value from the converter is applied to the comparator CO and compared within it to the value set in advance for the comparator. Thus the output of the comparator will be high when the measurement voltage is switched on and the short circuit is satisfactory. At an unsatisfactory level the comparator output will be low. With a proper short circuit the comparator output will also be alternately high and low.

[0035] The pulse detector PD is connected to the output of the comparator CO. Only if the output is a square wave can the safe signal be given. All other situations produce an alarm.

[0036] Pulsed measurement is used for the following reasons:

- To save energy, a smaller battery;
- The entire detection circuit is switched at the rate of interruption of the measurement voltage. The comparator determines if the signal is sufficiently high and low at the pulse rate used, which is checked. The output is also controlled at the same rate, which must also receive an alternating voltage, if it is to deliver a safety signal. In this way the reliability of the system is increased greatly. Moreover, in this way the correct functioning of the measuring circuit can be checked each time.

In order to show that a proper short circuit has been applied, which complies with the requirements, a continuous or intermittent light signal can be used that is clearly visible to the personnel carrying out the work. The signalling device can also be so constructed that external signalling is possible, for example to the traffic controller. Transmission and reception are also possible.

[0037] In an alarm situation, both light and audible warning signals could be generated. An electronic solution could be considered, such as a reliable transistor or FET circuit, but switching of light and audible signals through the break contacts of a so-called B relay is another possible method. In a safe situation the self-signalling short circuit lance should hold the B relay in the powered state. An electronic solution could be preferable for various reasons.

[0038] An additional test button will be included in the detection device circuit to test that an alarm signal will be given.

[0039] There should preferably be protection against removal of the short circuit link and/or the detection device by unauthorized persons. One possibility is that the connection and attachment of the self-signalling short circuit system and the short circuit lance should only be removed using one unique key.

[0040] A reliable short circuit measurement is guaranteed by the increase in the voltage across the inductance. This increase only takes place if there is a circuit of sufficiently low ohmic value between the measuring unit, the short circuit lance and the rails.

[0041] The following faults can appear in a properly placed short circuit:

- loss of the supply voltage
- loss of the 17 kHz alternating voltage
- defective pulse generator (continuously open or closed)
- open circuit in the LC circuit
- short circuit in the capacitor or inductance
- defective RMS converter
- defective pulse detector.

[0042] In all these cases no safety signal will be given. The detection device can possibly be constructed with the additional feature of indicating that the short circuit is unsatisfactory or that the measuring unit is defective.

Claims

1. Detection device (DT) for detecting adequate short-circuiting of a short circuit link (KL) to be applied between or across the rails (S1,S2) of a section of railway track, comprising a source of electrical energy (W2) and a monitoring device (L,C,CO), which, in use, are connected to the rails for measuring and monitoring the short circuit resistance caused by the short circuit link, in which the electrical energy source (W2) is an alternating current source and the monitoring device comprises a resonant circuit (L, C) and an evaluation device (CO) for the evaluation of the resonance produced in the resonant circuit, wherein the resonant circuit comprises a series connection of an inductance (L) and a capacitor (C), which is connected at one side to an output terminal of the alternating current source, of which the other output terminal, in use, is connected to the one rail (S1) and which, in use, is connected at the other side to the other rail (S2) and that the inductance is connected to a comparator (CO) for comparison of the inductance output signal with a reference signal (REF).

2. Detection device according to claim 1, **characterized in** that the inductance is connected to the comparator through an RMS converter (RMSC).

3. Detection device according to claim 2, **characterized in** that the RMS converter is connected to the inductance through a band-pass filter (B).

4. Detection device according to claim 1, 2 or 3, **characterized in** that a pulse generator (SN) is present to control the intermittent connection of the series connection of the alternating current source and the resonant circuit formed by the capacitor and the inductance to the rails and that the comparator output is connected to a pulse decoders (PD).

Patentansprüche

1. Erfassungseinrichtung (DT) für ein Erfassen eines hinreichenden Kurzschließens einer zwischen den oder über die Schienen (S1, S2) eines Schienengleisabschnitts anzulegenden Kurzschlußverbindung (KL), umfassend eine Quelle elektrischer Energie (W2) und eine Überwachungseinrichtung (L, C, CO), die im Gebrauch für ein Messen und Überwachen des durch die Kurzschlußverbindung hervorgerufenen Kurzschlußwiderstands mit den Schienen verbunden sind, wobei die Quelle elektrischer Energie (W2) eine Wechselstromquelle ist und die Überwachungseinrichtung einen Resonanzschaltkreis (L, C) sowie eine Bewertungseinrichtung (CO) für die Bewertung der in dem Resonanzschaltkreis erzeugten Resonanz umfaßt, wobei der Resonanzschaltkreis eine Reihenschaltung einer Induktivität (L) und eines Kondensators (C) umfaßt, die an einer Seite mit einem Ausgangsanschluß der Wechselstromquelle verbunden ist, deren anderer Ausgangsanschluß im Gebrauch mit der einen Schiene (S1) verbunden ist, und die im Gebrauch an der anderen Seite mit der anderen Schiene (S2) verbunden ist, und wobei die Induktivität mit einem Vergleicher (CO) verbunden ist für einen Vergleich des Ausgangssignals der Induktivität mit einem Referenzsignal (REF).

2. Erfassungseinrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Induktivität über einen RMS-Wandler (RMSC) mit dem Vergleicher verbunden ist.

3. Erfassungseinrichtung nach Anspruch 2, dadurch gekennzeichnet, daß der RMS-Wandler über ein Bandpaßfilter (B) mit der Induktivität verbunden ist.

4. Erfassungseinrichtung nach Anspruch 1, 2 oder 3, dadurch gekennzeichnet, daß ein Pulsgenerator (SW) vorgesehen ist, um die intermittierende Verbindung der Reihenschaltung der Wechselstromquelle und des durch den Kondensator und die Induktivität gebildeten Resonanzschaltkreises mit den Schienen zu steuern, und daß der Ausgang des Vergleichers mit einem Pulsdecoder (PD) verbunden ist.

Revendications

1. Dispositif de détection (DT) pour la détection d'un court-circuit adéquat d'une liaison de court-circuit (KL) devant être appliquée entre ou en travers des rails (S1, S2) d'un segment de voie ferroviaire, comprenant une source d'énergie électrique (W2) et un dispositif de contrôle (L, C, CO) qui, en utilisation, sont connectés aux rails pour la mesure et le contrôle de la résistance de court-circuit créée par la liaison de court-circuit, dans lequel la source d'énergie électrique (W2) est une source de courant alternatif et le dispositif de contrôle comprend un circuit résonnant (L, C) et un dispositif d'évaluation (CO) pour l'évaluation de la résonance produite dans le circuit résonnant, dans lequel le circuit résonnant comprend une connexion en série d'une bobine d'induction (L) et d'un condensateur (C), qui est connecté d'un côté à une borne de sortie de la source de courant alternatif, dont l'autre borne de sortie, en utilisation, est connectée au premier rail (S1) et qui, en utilisation, est connecté de l'autre côté à l'autre rail (S2), et dans lequel la bobine d'induction est connectée à un comparateur (CO) pour une comparaison du signal de sortie de bobine d'in-

duction avec un signal de référence (REF).

2. Dispositif de détection selon la revendication 1, caractérisé en ce que la bobine d'induction est connectée au comparateur via un convertisseur RMS (RMSC).

3. Dispositif de détection selon la revendication 2, caractérisé en ce que le convertisseur RMS est connecté à la bobine d'inductance via un filtre passe-bande (B).

4. Dispositif de détection selon la revendication 1, 2 ou 3, caractérisé en ce qu'un générateur d'impulsions (SW) est présent pour commander la connexion intermittente de la connexion en série de la source de courant alternatif et du circuit résonnant formé par le condensateur et la bobine d'induction avec les rails et en ce que la sortie de comparateur est connectée à un décodeur d'impulsion (PD).

Fig-1

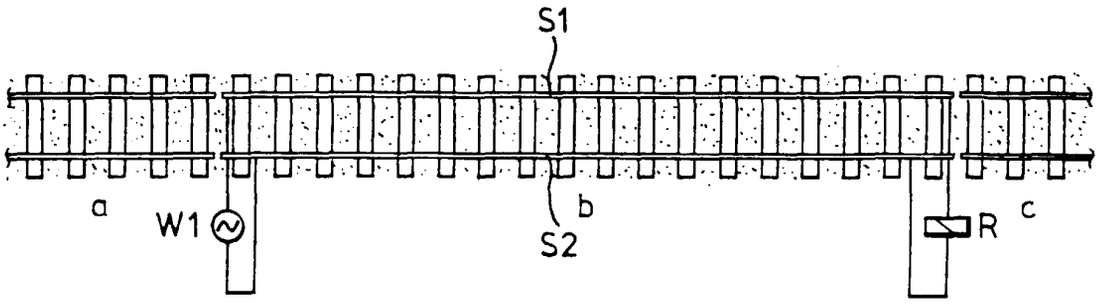

Fig-2