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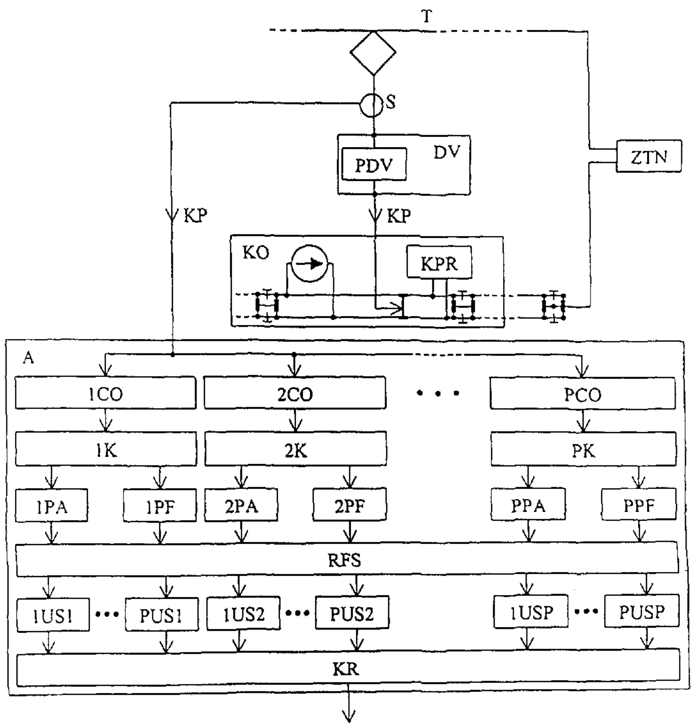
(54) Title: METHOD OF THE PHASE-SENSITIVE EVALUATION OF THE CONDUCTIVE CURRENT OF THE TRACK CIRCUIT




**(57) Abstract:** The method of the phase-sensitive evaluation of the conductive current (KP) of the track circuit (KO) is performed in such a manner, that its course is investigated for the presence of the first frequency (1 K), the second frequency (2K) up to the last frequency (PK), and the respective time windows (1 CO, 2CO up to PCO) are assigned to those frequencies, by which the time segmentation of the conductive current (KP) is performed with the aim of stating the values of all primary-range, secondary-range up to the last-range partial amplitudes (1 PA, 2PA up to PPA) of actual values (OH) of the conductive current (KP), as well as the values of all respective primary-range, secondary-range up to the last-range partial phases (1 PF, 2PF- up to PPF) of the actual values (OH) of the conductive current (KP) so, hat the values of all primary-range, secondary-range, up to the last-range effective components (US1 , US2 up to USP) are evaluated as above-limit values (N), if they have at one polarity, i.e. if they have the relevant phase (KRF), for a longer period than critical time (KC) is the above-limit value (NH), necessary for the excitation of the track receiver (KPR) in terms of the criterion (KR) of the endangering currents (OP). In analyzer (A) the conductive current (KP) can be analysed so, that the presence of the first frequency (1 K), the second frequency (2K), up to the last frequency (PK) is investigated by means of the first adaptive filter (1AF) tuned for the first frequency (1 K), the second adaptive filter (2AF) tuned for the second frequency (2K), up to the last adaptive filter (PAF) tuned for the last frequency (PK).

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# Method of the phase-sensitive evaluation of the conductive current of the track circuit

## Field of Invention

The invention concerns the phase-sensitive evaluation of the conductive current of the track circuit, which is part of the railway signalling equipment. Conductive currents are generated in driving units of railway vehicles with asynchronous engines, which are supplied by track voltage of DC traction or AC traction. Conductive currents flow through a track circuit because, that one rail or both rails are part of a back line, directed to the second pole of the source of the trolley voltage.

## Background of Invention

Conductive currents flowing through track circuits are currently evaluated either in an analogue manner with the use of an analogue selective ammeter, which directly evaluates the effective value of the conductive currents in the area of track circuit frequencies, or also digitally with the use of harmonic analysis in the area of frequency of track circuit.

The disadvantage of currently known evaluation methods of the conductive current is the fact, that in most cases there is no correct evaluation of conductive currents, due to this fact the result of the evaluation is not often exact, and can even be misleading. In many cases it is not taken into consideration, that not all conductive currents of the stated intensity, which are in the frequency band of the respective track circuit, are the endangering currents. Endangering currents are currents, whose time of duration, intensity, frequency and relevant phase may cause an excitation of the received phase-sensitive 2-phase track receiver.

## Summary of Invention

The above mentioned disadvantages of the currently know evaluation method of conductive currents flowing through the track circuits of railway signalling equipment are removed or significantly restricted in the manner of the phase sensitive evaluation of the conductive current of the track circuit, in accordance with this invention, whose nature lies in the fact, that the course of the conductive current investigated for the presence of the first frequency of the track circuit, which has assigned the first time window, in the analyser is analysed in such a manner, that after the performing of the time segmentation by the first time window, the values of all primary-range partial amplitudes of the actual values of the conductive current are stated, as well as the values of all respective primary-range partial phases of the immediate values of the conductive current. The values of all primary-range effective components, i.e. the first primary-range effective component, the second primary-range effective component, up to the last primary-range effective component of the endangering currents for the first frequency, are stated towards the reference phase network, i.e. towards the first reference phase, the second reference phase up to the last reference phase. The first primary-range effective component or the second primary-range effective component or up to the last primary-range effective component of the endangering currents for the first frequency is evaluated as an above-limit value, if it has at one polarity, i.e. if the relevant phase is longer, than the critical time, an above-limit value, necessary for excitation of the track receiver in terms of the criterion of the endangering currents. The course of the conductive current, investigated for the presence of the second frequency of the track circuit, which has assigned the second time window, is analysed in the analyser in such a manner, that after performing the time segmentation by the time window, the values of either all secondary-range partial amplitudes of actual values of the conductive current are stated, as well as the values of all respective secondary-range partial amplitudes of the actual values of the conductive current. The values of all secondary-range effective components, i.e. the first secondary-range effective component, the second secondary-range effective component, up to the last secondary-range effective component of the endangering currents for the second frequency, are stated towards the reference phase network, i.e. towards the first reference phase, the second reference phase and up to the last reference phase. The first secondary-range effective component or the second secondary-range effective component or up to the last secondary-range effective component of endangering currents for the second frequency is evaluated as an above-limit value, if it has at one polarity, i.e. if it has the relevant phase, longer than the critical time an above-limit value, necessary for the excitation of the track receiver in terms of the criterion of endangering currents. The course of the conductive current is investigated for the presence of other frequencies of the track circuit up to the last frequency of the track circuit, which has assigned the last time window, and is analysed in the analyser so, that after performing the time segmentation by the last time window, the values of all the last-range partial amplitudes of the actual values of the conductive current are stated, as well as the values of all respective last-range partial phases of actual values of conductive current so, that the values of all last-range effective components, thus the first last-range effective component, the second last-range effective component, up to the last-range effective component of the endangering currents for the last frequency, are stated towards the reference phase network, i.e. towards the first reference phase, the second reference phase, up to the last reference phase. The first last-range effective component or the second last-range effective component or to up final last-range effective component of the endangering currents for the last frequency, is evaluated as an above-limit value, if it has at one polarity, i.e. as far as it has the relevant phase, longer than the critical time an above-limit values, necessary for the excitation of the track receiver in terms of the criterion of endangering currents. If any effective component, i.e. none of the primary-range effective components for the first frequency, none of the secondary-range effective components for the second frequency, up to none of the last-range effective components for the last frequency of the track circuit, do not exceed at one polarity, i.e. at the relevant phase, for a period longer than the critical time, the above limit value, necessary for the excitation of the track receiver according to the criterion of endangering current, then the endangering current is indicated by the analyser as an under-limit value.

It is also suitable, when the course of the conductive current investigated for the presence of the first frequency, the second frequency, up to the last frequency of the track circuit is analysed in the analyser so, that the presence of the first frequency, the second frequency, up to the last frequency is investigated by means of the first adaptive filter tuned to the first frequency, the second adaptive filter tuned for the second frequency, up to the last adaptive filter tuned for the last frequency. Using such achieved values of signals regarding the first frequency, the second frequency, up to the last frequency, the values are stated of all partial amplitudes, i.e. the primary-range partial amplitudes, secondary-range partial amplitudes, up to the last-secondary partial amplitudes of the actual values of the conductive current, as well as the values of all corresponding partial phases, i.e. the primary-range partial phase, the secondary-range partial phase, up to the last-range partial phase of the actual values of the conductive current.

The main advantage of the method of the phase-sensitive evaluation of the conductive current of the track circuit according to this invention, is based on the fact, that there is the correct evaluation of endangering currents, i.e. these currents from the above-set of conductive currents, which may cause an excitation of the track receiver of the track circuit. According to this invention, the endangering currents must have not only the frequency in the relevant frequency band of the track circuit and the above-limit value of the amplitude, but mainly they must have the relevant phase, related to the reference phase at least during the critical period. Due to this fact there is not to an incorrect evaluation of those conductive currents, which are not endangering.

## Brief Description of the Drawings

The invention is explained by means of a generalized schematic drawing of the basic implementation according to Figure 1.

Figure 2 shows an exemplary implementation of the reference phase network.

Figure 3 shows an exemplary performance of the dependence of variable length of time windows on the individual frequencies.

Figure 4 shows an exemplary implementation of segmentation of the conductive current by the first time window.

Figure 5 shows an example of performance the criterion of endangering currents, with respect to the critical time and the above-limit value of the current.

Figure 6 shows an example of implementation the criterion of endangering currents, with respect to the relevant phase.

Figure 7 shows an exemplary implementation of the method of obtaining of frequencies of the track circuit by adaptive filters.

Figure 8 shows an example of execution of time overlapping in the time segmentation with the use of the first time window.

## Detailed Description of the Preferred Embodiments

The method of phase-sensitive evaluation of the conductive current **KP** of the railway circuit **KO** is evident from the generalized schematic drawing of the basic execution, mentioned in Fig. 1, then from the example of implementation of the reference phase network **RFS** according to Fig. 2, as well as from the example of performance the dependence of time windows **CO** on individual frequencies according to Fig. 3, also from the example of implementation of the segmentation of conductive current **KP** by the first time window **1CO** according to Fig. 4, as well from the example of implementation of the criterion **KR** of the endangering currents **OP** with respect of the critical time **KC** and the above-limit value of the current according to Fig. 5 and from the example of the implementation of the criterion **KR** of endangering currents **OP** with respect to the relevant phase **KRF** according to Fig. 6.

The course of the conductive current **KP** investigated for the presence of the first frequency **1K** of the track circuit **KO**, which has assigned the first time window **1CO**, is analysed in analyser **A**, that after performing the time segmentation by the first time window **1CO,** the values of all primary-range partial amplitudes **1PA** of the actual values **OH** of the conductive current **KP** are stated, as well as all respective primary-range partial phases **1PF** of the actual values **OH** of the conductive current **KP**.

The values of all primary-range effective components **US1**, i.e. the first primary-range effective component **1US1**, the second primary-range effective component **2US1**, up to the last primary-range effective component **PUS1** of the endangering currents **OP** for the first frequency **1K**, are stated towards the reference phase network **RFS**, i.e. towards the first reference phase **1RF**, the second reference phase **2RF**, up to the last reference phase **PRF**. The first primary-range effective component **1US1** or the second primary-range effective component **2US1** or up to the last primary-range effective component **PUS1** of the endangering currents **OP** for the first frequency **1K**, is evaluated as above-limit, if it has at one polarity, i.e. if it has the relevant phase **KRF**, longer than the critical time **KC** and the above-limit value **NH**, necessary for excitation of the track receiver **KPR** in terms of criterion **KR** of the endangering currents **OP**.

The course of the conductive current **KP** investigated for the presence of the second frequency **2K** of the track circuit **KO**, which has assigned the second time window **2CO**, is analysed in analyser **A** so, that after performing the time segmentation by the second time window **2CO**, the values of all secondary-range partial amplitudes **2PA** of the actual values **OH** of the conductive current **KP** are stated, as well as all respective secondary-range partial phases **2PF** of the actual values **OH** of the conductive current **KP**. Values of all secondary-range effective components **US2**, i.e. the first secondary-range effective component **1US2**, the second secondary-range effective component **2US2**, up to the last secondary-range effective component **PUS2** of the endangering currents **OP** for the second frequency **2K**, are stated towards the reference phase network **RFS**, i.e. towards the first reference phase **1RF**, the second reference phase **2RF**, up to the last reference phase **PRF.**

The first secondary-range effective component **1US2** or the second secondary-range effective component **2US2** or up to the last secondary-range effective component **PUS2** of the endangering currents **OP** for the second frequency **2K**, is evaluated as above-limit value **N**, if it has at one polarity, i.e. if it has relevant phase **KRF**, longer than the critical time **KC** and the above-limit value **NH** of the current, necessary for excitation of the track receiver **KPR** in terms of the criterion **KR** of the endangering currents **OP**.

If a none effective component, i.e. none of the primary-range effective components **US1** for the first frequency **1K**, none of the secondary-range effective components **US2** for the second frequency **2K** up to none of the last-range effective components **USP** for the last frequency **PK** of the track circuit **KO**, do not exceed at one polarity, i.e. at the relevant phase **KRF**, during a period longer than is the critical time **KC** the above-limit value **NH**, necessary for excitation of the track receiver **KPR** according to the criterion **KR** of the endangering currents **OP**, the endangering current **OP** is indicated by analyser **A** as the under-limit value **P**.

The method of phase-sensitive evaluation of the conductive current of the track circuit according to the invention is evident from the example of the implementation of the evaluation of relevant frequencies by adaptive filters according to Fig. 7, where the invention is implemented so, that the course of the conductive current **KP**, investigated for the presence of the first frequency **1K**, the second frequency **2K**, up to the last frequency **PK** of the track circuit **KO**, is analysed in analyser **A** so, that the presence of the frequency **K**, i.e. the first frequency **1K**, the second frequency **2K**, up to the last frequency **PK**, is investigated according to the first adaptive filter **1AF** tuned to the first frequency **1K**, the second adaptive filter **2AF** tuned to the second frequency **2K**, up to the last adaptive filter **PAF**, tuned to the last frequency **PK.** Such achieved values of signals regarding the first frequency **1K**, the second frequency **2K**, up to the last frequency **PK**, are used for specification of values of all partial amplitudes, i.e. the primary-range partial amplitudes **1PA**, secondary-range partial amplitudes **2PA** up to the last-range partial amplitudes **PPA** of actual values **OH** of the conductive current **KP**, as well as values of all respective partial phases, i.e. the primary-range partial phase **1PF**, secondary-range partial phase **2PF** up to the last-range partial phase **PPF** of actual values **OH** of the conductive current **KP**.

It results from the schematic drawing of the basic variant mentioned in Fig. 1, that the conductive current **KP** is closed in the current circuit, which forms the source **ZTN** of trolley voltage, trolley **T**, drives **PDV** of the railway vehicle **DV**, further track circuit **KO**, from where it returns back to the source **ZTN** of trolley voltage. The course of the conductive current **KP** is scanned in this example of implementation by sensor **S**, which is localized on the railway vehicle **DV** so, that it is then analysed in analyser **A**.

It results from Fig. 2, that the reference phase network **RFS** is implemented in the mentioned example so, that the first reference phase **1RF** has from the second reference phase **2RF** and then next the equidistant phase angle of 30°.

It results from Fig. 3, that depending on time windows **CO** at frequency **K** the first time window **1CO**, the second time window **2CO**, up to the last time window **PCO** is assigned mostly with the variable value to the respective frequencies, i.e. to the first frequency **1K**, the second frequency **2K**, (n-1)-th frequency **[n-1]K**, n-th frequency **nK**, (n+1)-th frequency **[n+1]K**, to the last but one frequency **[P-1]K** and in the end to the last frequency **PK**.

In Fig. 4 there is an example of the implementation of the time segmentation of the conductive current **KP** by the first time window **1CO**. It is displayed in the dependence of the conductive current **KP** on the time **t**.

It results from Fig. 5 in the mentioned example of the implementation of the criterion **KR** of endangering currents **OP** in terms of critical time **KC** and the above-limit value **NH**, corresponding to the effective value of the intensity of the current of the excitation of the track receiver **KPR**, the first under-critical time **1C** is equal to the second under-critical time **2C**, and these times can have the value, e.g. 100 ms.

Implementation of the criterion **KR** of endangering currents **OP** for the relevant phase **KRF** is evident from Fig. 6, when the field of the relevant phase **KRF** is displayed by the full line with the angle 180°, i.e. for one half-area of this arrangement, in other words, for one of the polarities of the possible phases.

Fig. 7 shows an example of the implementation of the alternative manner of gathering of frequency <u>K</u>, i.e. the first frequency <u>1K</u>, the second frequency <u>2K</u>, up to the last frequency <u>PK</u>, by means of the first adaptive filter <u>1AF</u>, the second adaptive filter <u>2AF</u> up to the last adaptive filter <u>PAF</u>.

Fig. 8 shows an alternative example of the implementation of the invention so, that in the time segmentation with the application of the first time window <u>1CO,</u> the time overlap <u>1CP</u> is used in high exposure parties of the analysed courses of the conductive current <u>KP</u>.

It is evident from the generalized schematic drawing of the basic variant of the implementation mentioned in Fig. 1, then from the example of the implementation of the reference phase network <u>RFS</u> according to Fig. 2, also from the example of the implementation of the segmentation of the conductive current <u>KP</u> by the first time window <u>1CO</u> according to Fig. 4, from the example of the implementation of the criterion <u>KR</u> of endangering currents <u>OP</u> with respect to the critical time <u>KC</u> and to the above-limit value <u>NH</u> of the endangering current <u>OP</u> according to Fig. 5 and from the example of the implementation of the criterion <u>KR</u> of endangering currents <u>OP</u> with respect to the relevant phase <u>KRF</u> according to Fig. 6, that by the saturation of the conductive current <u>KP</u> by the reference phase network <u>RFS</u> they gather for each frequency, i.e. for the first frequency <u>1K</u>, the second frequency <u>2K</u> up to the last frequency <u>PK</u>, of the track circuit <u>KO</u>, the effective components, i.e. the primary-range effective components <u>US1</u> for the first frequency <u>1K</u>, the secondary-range effective component <u>US2</u> for the second frequency <u>2K</u> up to the last-range effective component <u>USP</u> for the last frequency <u>PK</u>, is reflected to this reference phase network <u>RFS</u> and it is possible to evaluate them separately.

To be able to indicate conductive current <u>KP</u> as endangering current <u>OP</u>, it must have during the critical time <u>KC</u>, the relevant phase <u>KRF</u>, i.e. each effective component must have only one polarity, and must also achieve the above-limit value <u>NH</u>, necessary for the excitation of the track receiver <u>KPR</u>.

The advantage of variable time windows CO during the segmentation of the course of the conductive current KP by the time window, e.g. by the first time window 1CO depending on the first frequency 1K, the second frequency 2K, up to the last frequency PK, is based on the fact, that there is to a significant selective evaluation of endangering currents OP, than individual time windows CO, i.e. the first time window 1CO, the second time window 2CO, up to the last time window PCO, would have a constant value.

It is evident from the example of the implementation of the evaluation of relevant frequencies by adaptive filters according to Fig. 7, that in analyser A the conductive currents KP are evaluated in such a manner, that the presence of the first frequency 1K, the second frequency 2K, up to the last frequency PK, is investigated by means of the first adaptive filter 1AF tuned to the first frequency 1K, the second adaptive filter 2AF tuned to the second frequency 2K, up to the last adaptive filter PAF tuned to the last frequency PK. This causes alternative realisation of the time segmentation by time windows CO, depending on the first frequency 1K, the second frequency 2K, up to the last frequency PK.

## Industrial Applicability

As resulting from the mentioned description, the method of the phase sensitive evaluation of the conductive current KP of the track circuit KO according to the invention, can be used mainly during the analysis of conductive currents KP, generated by high-powered asynchronous railway units. This mainly concerns the case, when conductive currents KP, generated by railway units, could contain the endangering currents OP up to the above-limit value NH, which would cause a false and very dangerous excitation of the track receiver KPR of the respective track circuit KO.

List of reference symbols

| | | |
|---|---|---|
| KP | - | conductive current |
| KO | - | track circuit |
| 1K | - | first frequency |
| 2K | | second frequency |
| PK | | last frequency |
| K | | frequency |
| 1CO | - | first time window |
| 2CO | | second time window |
| PCO | | last time window |
| CO | | time window |
| A | - | Analyser |
| OH | - | actual values |
| 1PF | - | Primary- range partial phase |
| 2PF | | Secondary-range partial phase |
| PPF | | Last-range partial phase |
| US1 | - | Primary-range effective components |
| US2 | | Secondary-range effective components |
| PUS | | Last-range effective components |
| 1US1 | - | First primary-range effective component |
| 2US1 | - | second primary-range effective component |
| PUS1 | - | last primary-range effective component |
| 1US2 | | first secondary-range effective component |
| 2US2 | | second secondary-range effective component |
| PUS2 | | last secondary-range effective component |
| USP | | last-range effective component |
| 1USP | | first last-range effective component |
| 2USP | | second last-range effective component |
| PUSP | - | last last-range effective component |

RFS - reference phase network
1RF - first reference phase
2RF - second reference phase
PRF - last reference phase
KRF - relevant phase
KC - critical time
1C first under critical time
2C second under critical time

NH - Above-limit value NH of endangering currents OP
KPR - track receiver
KR - Criterion
N Above-limit value
P Under-limit value

1PA - Primary-range partial amplitudes
2PA - Secondary-range partial amplitudes
PPA Last-range partial amplitudes
T - Trolley
ZTN Source ZTN of trolley voltage
DV railway vehicle
PDV drive PDV of railway vehicle
S sensor
1AF - first adaptive filter
2AF - second adaptive filter
PAF - last adaptive filter
1CP first time overlap

## CLAIMS

1. The method of the phase-sensitive evaluation of the conductive current of the track circuit is **characterized in that**

- a course of the conductive current (KP) investigated for the presence of the first frequency (1K) of the track circuit (KO), which is assigned the first time window (1CO), **is analyzed** in analyzer (A) so, that after performing of the time segmentation by the first time window (1CO), the values of all primary-range partial amplitudes (1PA) of the actual values (OH) of the conductive current (KP) are stated, as well as the values of all respective primary-range partial amplitudes (1PF) of the actual values (OH) of the conductive current (KP), so that
- the values of all primary-range effective components (US1), i.e. the first primary-range effective component (1US1), the second primary-range effective component (2US1), up to the last primary-range effective component (PUS1) of the endangering currents (OP) for the first frequency (1K), are stated towards the reference phase network (RFS), i.e. towards the first reference phase (1RF), the second reference phase (2RF), up to the last reference phase (PRF), where
- the first primary-range effective component (1US1) or the second primary-range effective component (2US1) or up to the last primary-range effective component (PUS1) of the endangering currents (OP) for the first frequency (1K), **is evaluated as above-limit value (N),** if it has at one polarity, so if it has the relevant phase (KRF), longer than critical time for (KC) the above-limit value (NH), necessary for excitation of the track receiver (KPR) in terms of the criterion (KR) of the endangering currents (OP), so that
- the course of the conductive current (KP) investigated for the presence of the second frequency (2K) of the track circuit (KO), which has assigned the second time window (2CO), **is analyzed in analyser** (A) so, that after performing the time segmentation by the

time window (2CO), the values of all secondary-range partial amplitudes (2PA) of the actual values (OH) of the conductive current (KP) are stated, as well as the values of all respective secondary-range partial phases (2PF) of the actual values (OH) of the conductive current (KP), so that

- the values of all secondary-range effective components (US2), i.e. the first secondary-range effective component (1US2), the second secondary-range effective component (2US2), up to the last secondary-range effective component (PUS2) of the endangering currents (OP) for the second frequency (2K), are stated towards the reference phase network (RFS), i.e. towards the first reference phase (1RF), the second reference phase (2RF), up to the last reference phase (PRF), whereas
- the first secondary-range effective component (1US2) or the second secondary-range effective component (2US2) or up to the last secondary-range effective component (PUS2) of the endangering currents (OP) for the second frequency (2K), **is evaluated as the above-limit value (N)**, if it has at one polarity, i.e. if has the relevant phase (KRF), longer than the critical time (KC) the above-limit value (NH), necessary for excitation of the track receiver (KPR) in terms of the criterion (KR) of the endangering currents (OP), whereas
- the course of conductive current (KP) is investigated for the presence of other frequencies of the track circuit (KO) up to the last frequency (PK) of the track circuit (KO), which has assigned the last time window (PCO), and **is analysed** in analyser (A) so, that after performing the time segmentation by the last time window (PCO), the values of all last-range partial amplitudes (PPA) of actual values (OH) of the conductive current (KP) are stated, as well as the values of all respective last-range partial phases (PPF) of the actual values (OH) of the conductive current (KP), so that
- the values of all last-range effective components (USP), i.e. the first last-range effective component (1USP), the second last-range

effective component (2USP), up to the final last-range effective component (PUSP) of the endangering currents (OP) for the last frequency (PK), are stated towards the reference phase network (RFS), i.e. towards the first reference phase (1RF), the second reference phase (2RF), up to the last reference phase (PRF) and,

- the first last-range effective component (1USP) or the second last-range effective component (2USP) or up to the final last-range effective component (PUSP) of the endangering currents (OP) for the last frequency (PK), **is evaluated as above-limit value (N),** if it has at one polarity, i.e. if it has the relevant phase (KRF), longer than the critical time (KC) the above-limit value (NH), necessary for excitation of the track receiver (KPR) in terms of the criterion (KR) of endangering currents (OP), and
- **if none of the effective component**, i.e. none of the primary-range effective components (US1) for the first frequency (1K), none of the secondary-range effective components (US2) for the second frequency (2K) up to none of the last-range effective components (USP) for the last frequency (PK) of the track circuit (KO), **do not exceed** at one polarity, i.e. at the relevant phase (KRF), for a period longer than the critical time (KC) for the above-limit value (NH), necessary for excitation of the track receiver (KPR) **according to the criterion** (KR) of the endangering currents (OP), **the endangering current (OP)** is indicated by analyzer (A) as an **under-limit value (P)**.

2. The method of the time-sensitive evaluation of the conductive current of the track circuit according to claim 1, **characterized in that**

- the course of the conductive current (KP), investigated for the presence of the first frequency (1K), the second frequency (2K), up to the last frequency (PK) of the track circuit (KO), **is analysed** in the analyzer(A) so, that the presence of the first frequency (1K), the second frequency (2K), up to the last frequency (PK) is investigated by means of the first adaptive filter (1AF) tuned for the first frequency (1K), the second adaptive filter (2AF) tuned for the second frequency (2K), up to the last adaptive filter (PAF) tuned for the last frequency (PK), where

- using of such achieved values of signals regarding the first frequency (1K), the second frequency (2K), up to the last frequency (PK), then the values of all partial amplitudes are stated, i.e. the primary-range partial amplitudes (1PA), secondary-range partial amplitudes (2PA) up to the last-range partial amplitudes (PPA) of the actual values (OH) of the conductive current (KP), as well as the values of all respective partial phases, i.e. the primary-range partial phase (1PF), the secondary-range partial phase (2PF) up to the last –range partial phase (PPF) of the actual values (OH) of the conductive current (KP).

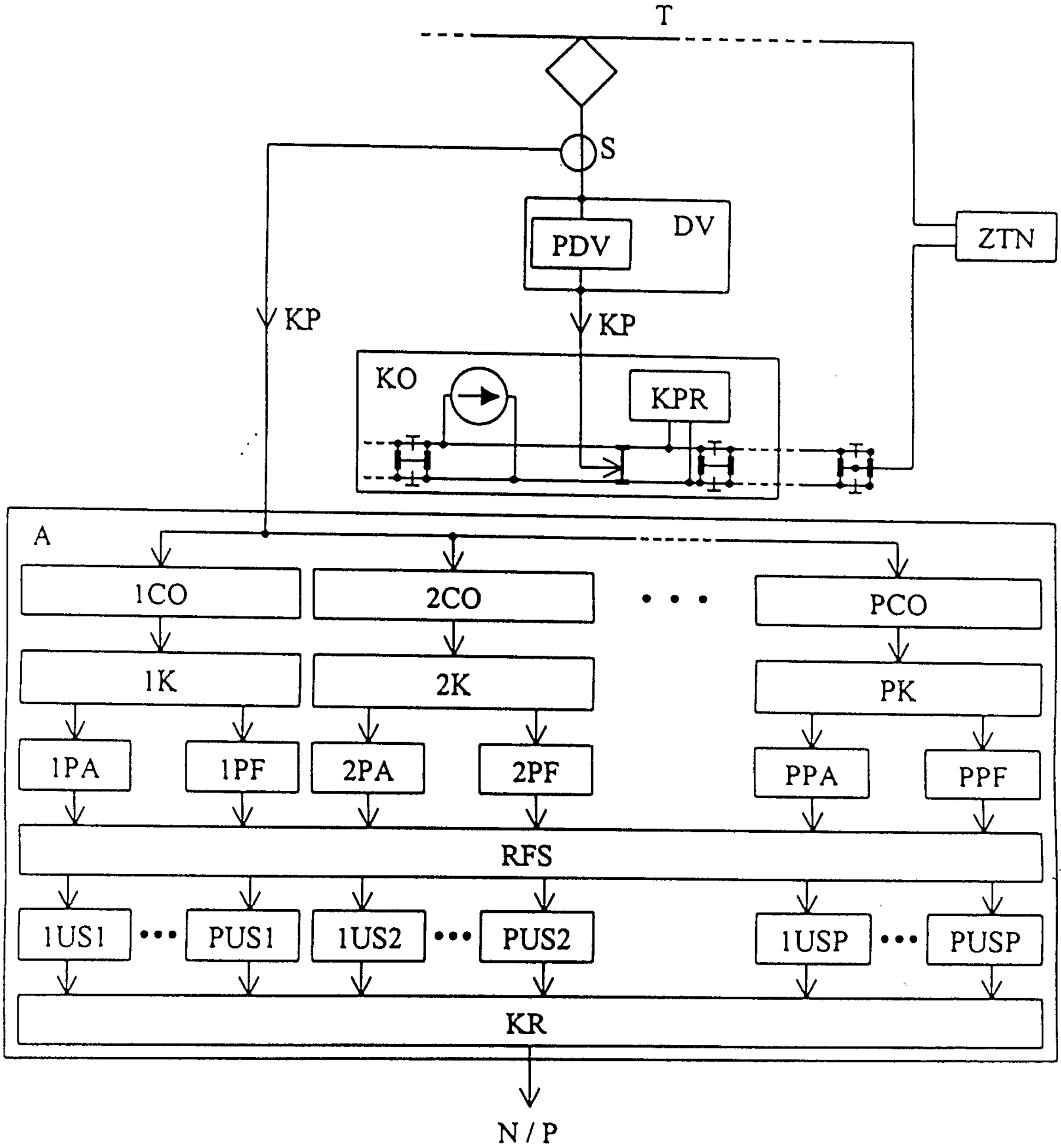
T
S
DV
PDV
ZTN
KP
KP
KO
KPR
A
1CO
2CO
PCO
1K
2K
PK
1PA
1PF
2PA
2PF
PPA
PPF
RFS
1US1
PUS1
1US2
PUS2
1USP
PUSP
KR
N / P

Fig. 1

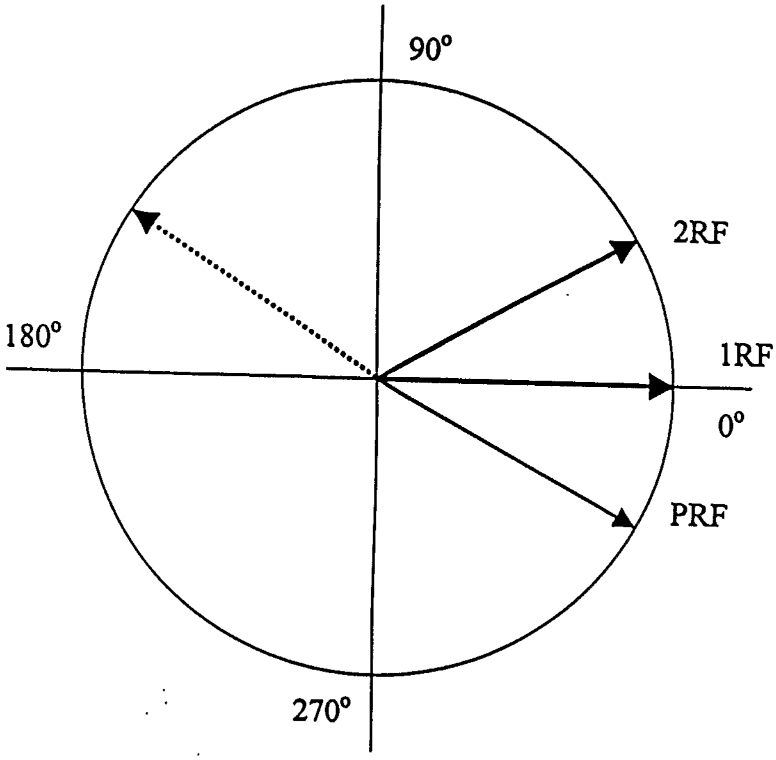
90°
2RF
180°
1RF
0°
PRF
270°

Fig. 2

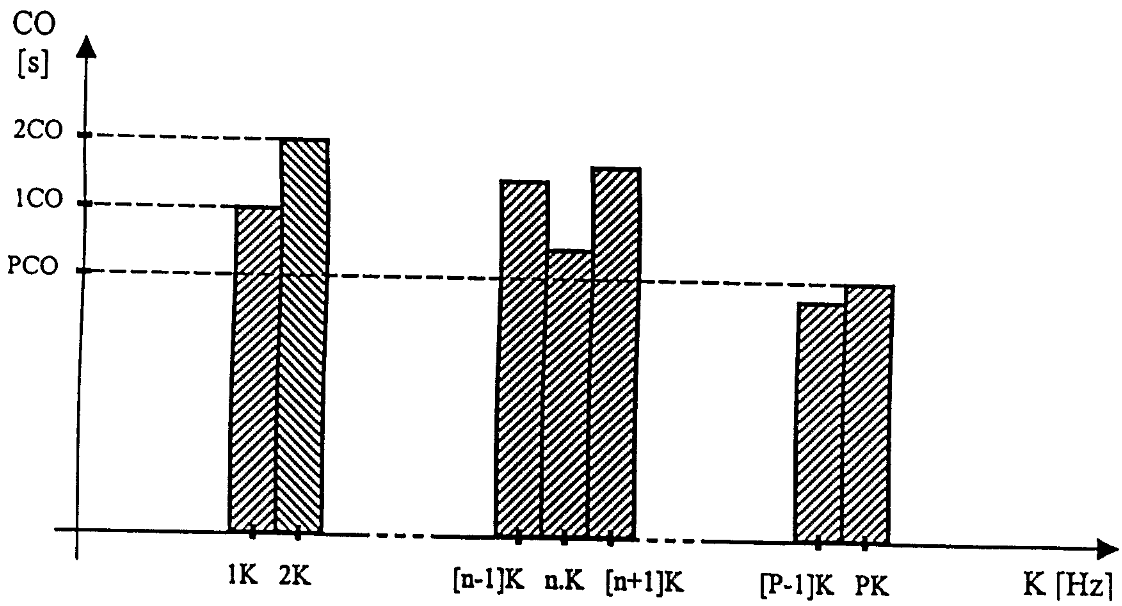
CO
[s]
2CO
1CO
PCO
1K
2K
[n-1]K
n.K
[n+1]K
[P-1]K
PK
K [Hz]

Fig. 3

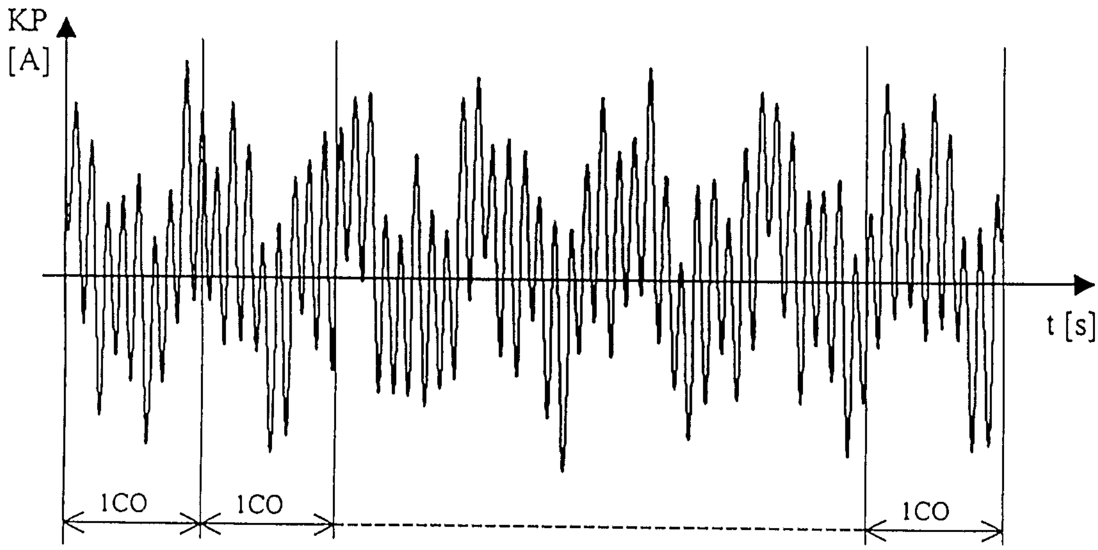


Fig. 4

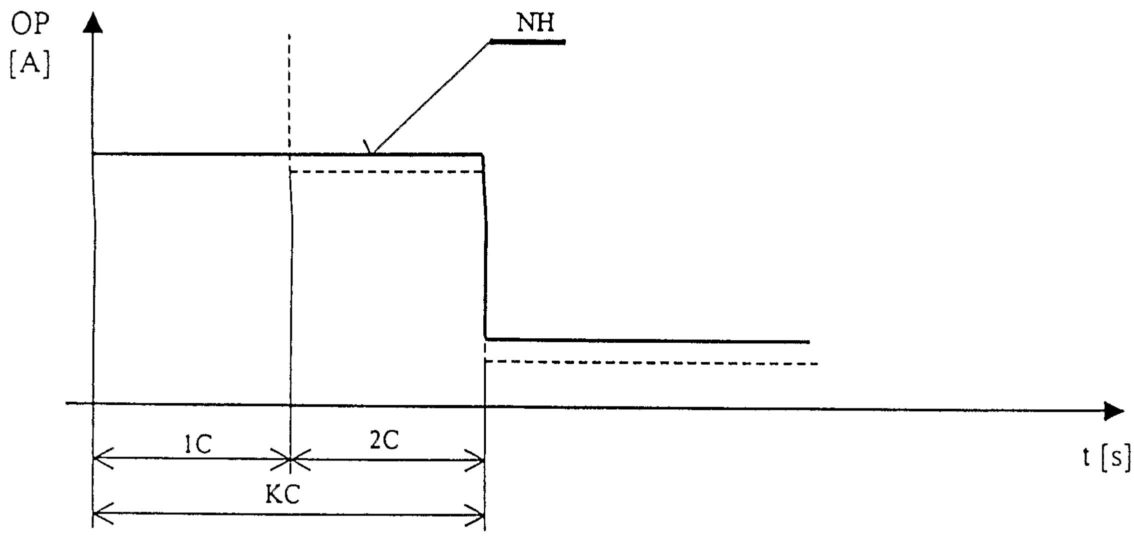


Fig. 5

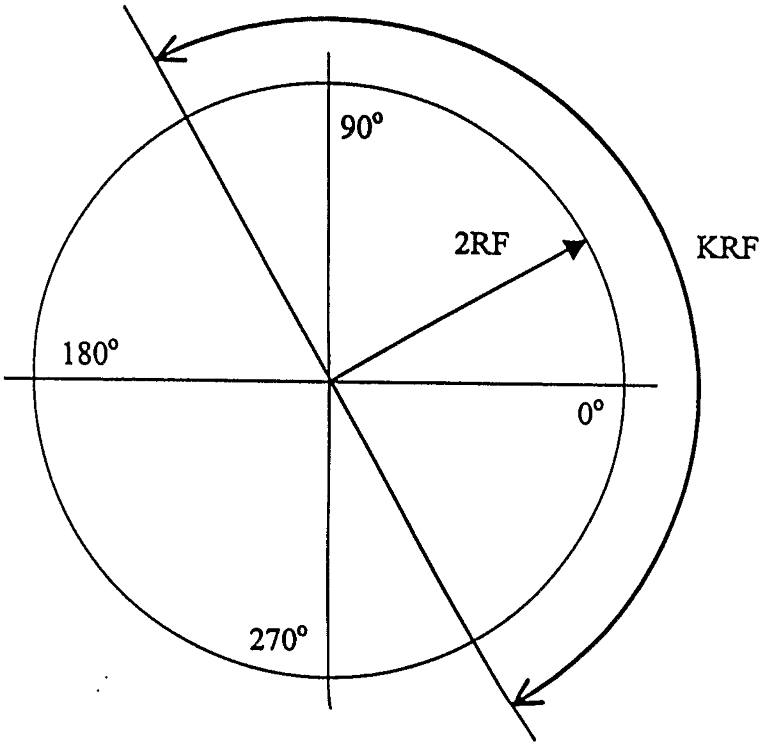


Fig. 6

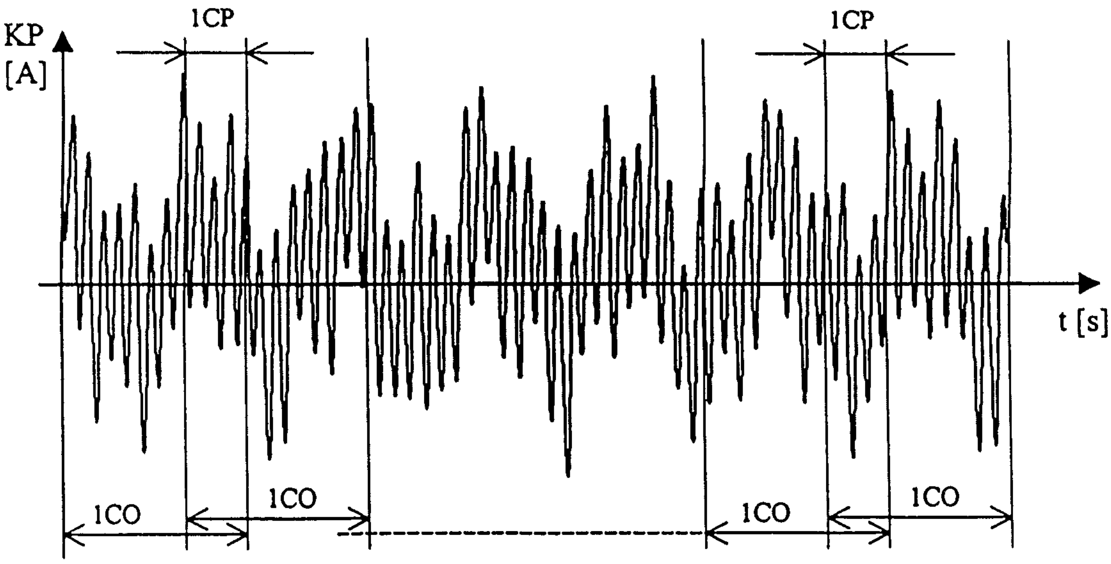


Fig. 7

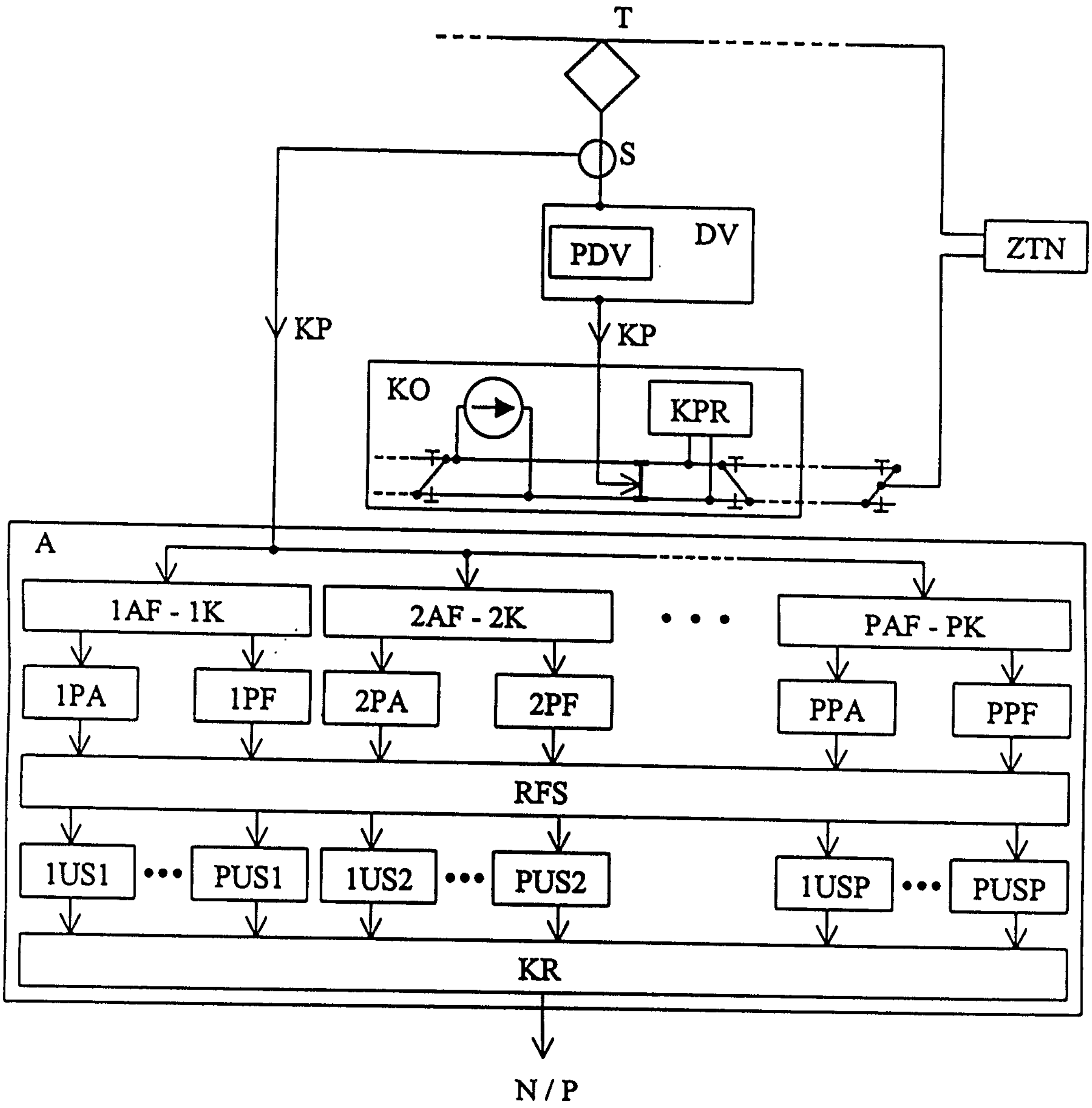
T
S
DV
PDV
ZTN
KP
KP
KO
KPR
A
1AF - 1K
2AF - 2K
PAF - PK
1PA
1PF
2PA
2PF
PPA
PPF
RFS
1US1
PUS1
1US2
PUS2
1USP
PUSP
KR
N / P

Fig. 8

# INTERNATIONAL SEARCH REPORT

International application No
PCT/CZ2006/000050

**A. CLASSIFICATION OF SUBJECT MATTER**
INV. G01R19/25 B61L1/20

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)
G01R B61L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 17 January 2007 | 25/01/2007 |

| Name and mailing address of the ISA/ | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016 | LOPEZ-CARRASCO, A |

# INTERNATIONAL SEARCH REPORT

International application No
PCT/CZ2006/000050

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