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(54) **Communication Device with compensation of transmitter leakage signals occuring at a receiver input**

Nachrichtengerät mit Kompensation von im Empfänger auftretenden Sender-Streusignalen

Dispositif de communications avec compensation de signal de diaphonie au receveur

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Description

[0001] The invention relates to a communication device comprising a transmitter and a receiver, coupled to antenna means respectively via a transmitter output and a receiver input, as well as corrective signal means arranged for reducing a transmitter leakage signal at the receiver input and provided with a transmitter signal reference input being coupled to the transmitter output.

[0002] Communication devices of such type, also being referred to as transceivers, are known e.g. from US patent nr. 5,444,864. In particular transceivers with single antenna means for transmission and reception require specific filtering between antenna, transmitter output and receiver input to protect the receiver during the transmission phase. The isolation between the transmitter output and the receiver input should be high enough to guarantee that the blocking voltage at the receiver input is not reached even under worst case situations where the output power of the transmitter is set to its maximum level and the reflection coefficient of the antenna reaches its maximum value due to body effects. In the known communication device use is made a.o. of a socalled diplexer interconnecting the antenna means with the receiver input and the transmitter output for the purpose of directing signals received by the antenna means to the receiver input and signals to be transmitted from the transmitter output to the antenna means. To cancel the portion of the transmitter signal arriving at the receiver input, e.g. via leakage through the diplexer or electromagnetic radiation coupling, hereinafter also referred to as transmitter leakage signal, use is made of a socalled signal canceller, functioning as said corrective signal means. The signal canceller is to generate a cancellation signal, which is a substantially gain and phase matched estimate of the transmitter leakage signal measured at the receiver input and which is fed forward to the receiver input signal path via a summer, in which it is subtracted from the leakage transmitter signal.

US patent nr. 4,660,042 shows a system using a cancellation signal for canceling transmitter generated interference signals picked up by a receiver antenna, which is near the transmitter antenna. The cancellation signal is coupled out from the transmitter signal, corrected in delay, phase and amplitude and subsequently subtracted from the received interference signal prior to the receiver input. To obtain full cancellation, the cancellation signal should be an exact replies of the interference signal. This requires identical delay, phase and amplitude correspondence between the cancellation signal on the one hand and the interference signal on the other hand.

[0003] These known concepts of signal cancellation are highly demanding with regard to the accuracy and performance of the circuitry needed. For example, the conformity in phase and amplitude between the cancellation signal on the one hand and the leakage transmitter signal on the other hand is critical for a proper cancellation. Small mutual deviations strongly degrade the cancellation and may even result in an increase of transmitter leakage signal. Apart therefrom, these known concepts require the provision of circuitry, which inevitably cause unwanted side effects to occur, such as the summer of US patent nr. 5,444,864 and the subtractor in US patent nr. 4,660,042, which inherent to their function strongly reduces the overall signal to noise ratio.

[0004] It is a first object of the invention to overcome the above drawbacks of conventional communication devices and to increase the performance thereof.

[0005] A second object of the invention is to improve the sensitivity of the receiver in full duplex mode.

[0006] According to the invention a communication device comprising a transmitter and a receiver, coupled to antenna means respectively via a transmitter output and a receiver input, as well as corrective signal means arranged for reducing a transmitter leakage signal at the receiver input and provided with a transmitter signal reference input being coupled to the transmitter output, is therefore characterized in that the corrective signal means comprises transmitter leakage signal selective amplifying means including a frequency controlled filter arrangement using the transmitter output signal at the transmitter signal reference input (Tri) to lock the resonance frequency thereof to the carrier frequency of the transmitter leakage signal for selectively amplifying said transmitter leakage signal, a transmitter leakage signal input being coupled to the receiver input and a transmitter leakage signal output being coupled to said transmitter leakage signal input thereby forming a negative feed back of the transmitter leakage signal occurring at the receiver input.

[0007] The invention is based on the recognition that the phase and gain requirements to obtain an effective reduction of the transmitter leakage signal in a feed back loop are much easier to comply with than those to be complied with by the cancellation signal in a feed forward reduction of the transmitter leakage signal. Where the cancellation signal in the known communication device has to narrowly match the transmitter leakage signal in gain and phase, the gain of the leakage transmitter signal in the feedback loop according to the invention only has to be sufficiently large, whereas its phase only has to be reversed, i.e. shifted over a fixed 180°, to obtain an effective reduction thereof. Furthermore, the feedback concept allows to dispense with circuitry introducing unwanted side effects such as a summer.

[0008] A preferred embodiment of such communication device is characterized in that the transmitter leakage signal selective amplifying means comprise a phase splitter, an input thereof being coupled to the transmitter output, supplying respectively in-phase (I) and quadrature phase (Q) components of a transmitter signal to reference signal inputs of first and second demodulators. as well as to carrier signal inputs of first and second modulators, said first and second demodulators having a transmitter leakage signal input in common with a transmitter leakage signal terminal of the corrective signal means being coupled to the receiver input, and outputs being coupled respectively through first and second low pass filters to modulating signal inputs of said first and second modulators, an output of said modulators being coupled in common to the transmitter leakage signal inputs of said first and second demodulators and phase inverting means being included in the signal path of the transmitter leakage signal selective amplifying means.

[0009] By applying this measure, the pair of I and Q transmitter output signalcomponents, are respectively used in the first and second demodulators as a demodulation signal for a synchronous quadrature demodulation of the transmitter leakage signal occurring at the receiver input, resulting in I and Q baseband transmitter leakage signalcomponents. After a baseband selection in said first and second low pass filters, these I and Q baseband transmitter leakage signalcomponents are re-modulated using the I and Q transmitter output signalcomponents as modulation carrier signals. The so obtained re-modulated I and Q transmitter leakage signal components are negatively fed back to the receiver input. The phase inversion needed therefore is provided by said phase inverting means and can be applied anywhere in the loop, i.e. in the baseband or in the RF part of the loop.

[0010] For a combination of the re-modulated I and Q transmitter leakage signalcomponents into a single transmitter leakage signal at the receiver input without introducing signal distorsion or noise, preferably the first and second modulators each comprise transconductance amplifying means an output thereof being coupled in common to the receiver input and the transmitter leakage signal inputs of said first and second demodulators.

[0011] Another preferred embodiment of a communication device according to the invention is characterized in that the transmitter leakage signal selective amplifying means provides a non-linear, input signal amplitude dependent amplification of the selected transmitter leakage signal. This measure allows to adapt the degree of reduction of the transmitter leakage signal to its degrading effect on the receiver input signal, therewith saving power while maintaining optimum performance.

[0012] Preferably, the non-linear amplification is being provided by dead zone control means coupled between the first and second low pass filters on the one hand and the first and second modulators on the other hand providing in-phase and quadrature phase components of a baseband modulation signal having a dead zone for amplitude variations of the respective output signals of the first and second lowpass filters within a range between predetermined first and second threshold levels, the in-phase and quadrature phase components of said baseband modulation signal are varying in amplitude with the respective output signals of the first and second lowpass filters for amplitude variations beyond said range.

[0013] Dead zone signal amplification is on itself known, e.g. from US patent number 4,277,695. The use thereof in accordance with the above measure allows to adjust the operative range of the corrective means and to trade off noise against receiver performance degradation.

[0014] Preferably, said dead zone is being determined by the maximum allowable receiver input voltage. As a result thereof the operation of the corrective means is switched off for those transmitter leakage signals, which are acceptable and do not lead to performance degradation, hereinafter also referred to as desensitization. In said switched off state, the corrective means is prevented from reducing the signal to noise ratio of the receiver input signal.

[0015] Another preferred embodiment of a communication device according to the invention is characterized by a duplex filter having first and second stages, the transmitter output being coupled through said first stage to the antenna means, the antenna means being coupled through said second stage to the receiver input and to the transmitter signal reference terminal of the corrective signal means.

[0016] This measure further improves the performance of the communication device mainly in that a reduction in sideband noise is obtained therewith.

[0017] Another improvement in noise performance is achieved by an attenuator coupled between the antenna means and the transmitter leakage signal input of the corrective signal means.

[0018] Yet another preferred embodiment of a communication device according to the invention is characterized in that said dead zone control means comprises first and second in-phase signal splitters and first and second quadrature phase signal splitters for splitting said dead zone in-phase and quadrature phase components of the baseband modulation signal into positive and negative in-phase and positive and negative quadrature phase components, said positive, respectively negative, components being supplied to control inputs of first variable transconductor amplifiers of the first and second modulators, respectively through first and second phase inverters to second variable transconductor amplifiers of the first and second modulators, outputs of said first variable transconductor amplifiers and outputs of said second variable transconductor amplifiers through third and second phase inverters being coupled tc the transmitter leakage signal terminal of the corrective signal means.

[0019] This measure allows to combine the re-modulated positive and negative in-phase and positive and negative quadrature phase RF transmitter leakage signalcomponents into a single feed back transmitter leakage signal, without using a resistive voltage summing circuit, therewith preventing this combination from degrading the signal to noise ratio at the receiver input.

[0020] Preferably, variable transconductor amplifiers are used only for the amplitude varying ones of the positive and negative in-phase and positive and negative quadrature components of the dead zone baseband modulation signal. This results in a reduction of circuitry needed for an effective implementation of the communication device.

[0021] The above and other object features and advantages of the present invention will be discussed in more detail hereinafter with reference to the disclosure of preferred embodiments and in particular with reference to the appended Figures, that show:

Figure 1 a schematic diagram of a communication device according to the invention;
Figure 2 a blockdiagram of a preferred embodiment of a communication device according to the invention;
Figure 3 a blockdiagram of alternative corrective means for use in the communication device of Figures 1 or 2;
Figure 4 a characteristic diagram of the output control signal of the dead zone means for use in the communication device of Figures 1, 2 or 3;
Figure 5 a vector diagram illustrating the reduction of transmitter leakage in a communication device according to the invention;
Figure 6 a vector diagram illustrating the reduction of transmitter leakage in a communication device according to the invention when using a non-ideal quadrature phasesplitter.

[0022] Figure 1 shows a communication device according to the invention comprising a transmitter T and a receiver R, coupled respectively via a transmitter output To and a receiver input Ri to an input and an output of a duplex filter DF, an input/output terminal thereof being coupled via a bidirectional link to antenna means ANT. The communication device also comprise corrective signal means C for reducing a transmitter leakage signal Vl leaking through to and occurring at the receiver input Ri. The corrective signal means C is provided with a transmitter leakage signal terminal Tl being coupled to the receiver input Ri and with a transmitter signal reference input Tri being coupled to the transmitter output To. The corrective signal means C comprise transmitter leakage signal selective amplifying means A having a transmitter leakage signal input Tli coupled to the transmitter leakage signal terminal Tl for supplying thereto the transmitter leakage signal Vl occurring at the receiver input Ri. A transmitter leakage signal output Tlo of the selective amplifying means A is commonly coupled with the transmitter leakage signal input and the transmitter leakage signal terminal Tl, therewith closing a feedback loop. The selective amplifying means A provides for a selection, amplification (e.g. with factor α) and phase inversion or 180° phase shift of the transmitter leakage signal Vl, resulting in an output signal, in the given example $-\alpha Vl$, which is fed back to its transmitter leakage signal input effecting the transmitter leakage signal in the loop, i.e. the transmitter leakage signal occurring at the receiver input Ri, to reduce to $Vl/(1+\alpha)$.

[0023] For the selection of the transmitter leakage signal Vl, the selective amplifying means A may comprise any type of active frequency controlled filter arrangement using the transmitter output signal at the transmitter signal reference input Tri to lock the resonance frequency thereof to the carrier frequency of the transmitter leakage signal to be selected. The selective amplifying means A may alternatively be based on phase splitting of the transmitter leakage signal Vl into its in-phase (I) and phase quadrature (Q) signalcomponents, followed by mutually separated selection and amplification thereof and subsequent re-combination into a single transmitter leakage signal. This will be further clarified with reference to Figures 2 and 3.

[0024] Figure 2 shows a blockdiagram of a preferred embodiment of a communication device according to the invention, in which elements corresponding to those shown in Figure 1 have same references.

The transmitter leakage signal selective amplifying means A comprise a phase splitter 10, an input thereof being coupled to the transmitter signal reference input Tri, for splitting the transmitter output signal into a pair of in-phase (I) and phase quadrature (Q) signalcomponents and for supplying those respectively to reference signal inputs of first and second demodulators 1 and 2, as well as to carrier signal inputs of first and second modulators 7 and 8. Said first and second demodulators 1 and 2 both have an input in common with the transmitter leakage signal input of the transmitter leakage signal selective amplifying means A and the transmitter leakage signal terminal T1 of the corrective signal means C and provide for a synchronous quadrature demodulation of the transmitter leakage signal into a pair of baseband I and Q transmitter leakage signalcomponents. Outputs of the first and second demodulators 1 and 2 are respectively coupled through first and second low pass filters 3 and 4 for a selection of said baseband I and Q transmitter leakage signalcomponents to first and second dead zone control means 5 and 6 providing for a non-linear amplification of said baseband I and Q transmitter leakage signal components. The so amplified baseband I and Q transmitter leakage signalcomponents are thereafter respectively supplied to first and second modulators 7 and 8 providing a re-modulated pair of I and Q transmitter leakage signalcomponents, which are combined at the transmitter leakage signal output of the selective amplifying means A into one single re-modulated transmitter leakage signal. The circuitry 1, 3, 5, 7 and the circuitry 2, 4, 6, 8 therewith respectively form I and Q signal paths of the transmitter leakage signal selective amplifying means A, in which the I and Q transmitter leakage signalcomponents are being processed mutually separated. The re-modulated transmitter leakage signal is negatively fed back to the input of the transmitter leakage signal selective amplifying means A through a phase inverter 9.

[0025] The dead zone control means 5 and 6 provide zero output for any signal supplied to their input having a magnitude smaller than a certain predetermined threshold level, and provide high gain amplification (α) to input signals having a magnitude greater than said threshold level. This means, that for magnitudes of the transmitter leakage signals smaller than said threshold level the corrective means are not operative, this effect also being referred to as desensitization of the corrective means. By choosing said threshold level to correspond to the maximum receiver input voltage, a desensitization in correcting insignificant transmitter leakage signals is obtained, which does not degrade the overall receiver performance, while maintaining an effective reduction of significant transmitter leakage signals. Said desensitization furthermore prevents noise from being introduced in the receiver input signal. This all considerably increase the power efficiency as well as the sensitivity of the receiver when operating in full duplex mode.

[0026] The duplex filter DF may be constituted by a Fujitsu D5CG type duplex filter having a transmitter related portion DFT, also referred to as first stage, coupled to a receiver related portion DFR, also referred to as second stage, the common connection between those stages being coupled in common to the antenna means ANT and to an input of an attenuator ATT. An output of the attenuator ATT is coupled to the transmitter signal reference input Tri of the corrective signal means C. The transmitter output signal is supplied through the transmitter related portion DFT prior to the use thereof signal in the transmitter leakage signal selective amplifying means A as demodulation, respectively modulation signal. This results in a reduction of sideband noise at the receiver input. The attenuator ATT further improves the overall performance of the communication device.

[0027] Figure 3 shows a blockdiagram of alternative corrective means for use in the communication device of Figures 1 or 2, in which elements corresponding to those shown in Figure 1 have same references. The first and second modulators 7 and 8 are formed by respectively a pair of positive and negative controllable operational transconductor amplifiers 7' and 7" and a pair of positive and negative controllable operational transconductor amplifiers 8' and 8", signal inputs thereof being respectively coupled to the I and Q outputs of the phase splitter 10 and signal outputs thereof being fed back in common to the input of the transmitter leakage signal selective amplifying means A, i.e. the common input of the demodulators 1 and 2. The baseband I and Q transmitter leakage signalcomponents selected by the low passfilters 3 and 4 and amplified in the dead zone control means 5 and 6 are now being used to vary the gain of the respective operational transconductor amplifiers 7', 7", and 8', 8". Said operational transconductor amplifiers have no provision to deal with change in signal polarity of the gain control signal. To overcome this restriction, the dead zone control means 5 and 6 provide for a splitting of the signals to be processed on the basis of their polarity. This will be clarified with reference to Figure 4. The deadzone control means 5 and 6 are provided with positive and negative output terminals 5+ and 5-, respectively 6+ and 6-, the transfer characteristic of the deadzone control means 5 and 6 from their inputs to their respective positive output terminals 5+ and 6+ being represented by a solid line s and the transfer characteristic of the deadzone control means 5 and 6 from their inputs to their respective negative output terminals 5- and 6- being represented by a dotted line d. For input signal magnitudes smaller than a predetermined threshold value Vth, the signals CPI, respectively CPQ, at the output terminals 5+, 5-, 6+ and 6- have zero value. Positive baseband I and Q transmitter leakage signalcomponents selected by the low passfilters 3 and 4 having an amplitude increasing beyond +Vth will generate an outputsignal CPI/CPQ of the deadzone control means 5 and 6 at their respective positive output terminals 5+ and 6+ following the solid line curve s of Figure 4.

[0028] Negative baseband I and Q transmitter leakage signal components selected by the low passfilters 3 and 4 having an amplitude decreasing below -Vth will generate an output signal CPI/CPQ of the deadzone control means 5 and 6 at their respective negative output terminals 5- and 6- following the dotted line curve d of Figure 4. The threshold value Vth is preferably chosen to correspond to the maximum receiver input level The magnitudes of the output signals of the operational transconductor amplifiers are mutually similarly varying with the gain control signals, whereas their phase is either inphase or in anti phase with their input signals. By choosing the operational transconductor amplifiers 7' and 8' to vary in anti-phase with their input I transmitter leakage signalcomponent and the operational transconductor amplifiers 7" and 8" to vary in-phase with their input Q transmitter leakage signalcomponent a phase inversion is realised without the need for separate phase inverting means, such as the phase inverter 9 in Figure 2.

[0029] Figure 5 shows a vector diagram illustrating the reduction of transmitter leakage in a communication device according to the invention as shown in Figures 2 and 3, in which VI represents the transmitter leakage signal occurring at the receiver input Ri without the corrective signal means C. The I and Q components of this transmitter leakage signal VI, i.e. Vli and Vlq respectively, are separately suppressed in the I and Q signal paths to result in a suppressed transmitter leakage signal having a magnitude at most substantially equal to the maximum receiver input level, which is acceptable and does not degrade the performance noticeably.

[0030] The phase shift of the transmitter leakage signal VI occurring in the duplex filter DF will in practise not vary over 360°. This means, that not all four output signals CP1/CPQ of the deadzone control means 5 and 6 at their respective positive and negative I and Q output terminals 5+, 5- and 6+, 6- will vary in magnitude. Dependent from the I/Q phase quadrant(s), the vector representing the transmitter leakage signal VI occurring at the receiver input never enters, one or two of the operational transconductor amplifiers 7', 7", 8' and 8" can be omitted. For example, if vector VI only varies over a phase angle within the first I/Q phase quadrant (the projections of VI on the I and Q axis being positive), than only transconductor amplifiers 7' and 8' are needed and the operational transconductor amplifiers 7" and 8" can be dispensed with. This simplifies the implementation of the corrective signal means. In general, the phase shift of the duplex filter DF can be measured once and dependent on this phase shift one or more of the transconductor amplifiers 7', 7", 8' and 8" can be omitted.

[0031] Figure 6 shows a vector diagram illustrating the reduction of transmitter leakage in a communication device according to the invention when using a non-ideal quadrature phasesplitter 10. Despite of the non-orthogonal I/Q phase splitting, the corrective signal means according to the invention remain to be effective, reducing the I and Q components of the transmitter leakage signal VI to an acceptable magnitude.

Claims

1. Communication device comprising a transmitter (T) and a receiver (R), coupled to antenna means (ANT) respectively via a transmitter output (To) and a receiver input (Ri), as well as corrective signal means (C) arranged for reducing a transmitter leakage signal (VI) at the receiver input (Ri) and provided with a transmitter signal reference input (Tri) being coupled to the transmitter output (To), **characterized in that** the corrective signal means (C) comprises transmitter leakage signal selective amplifying means (A) including a frequency controlled filter arrangement using the transmitter output signal at the transmitter signal reference input (Tri) to lock the resonance frequency thereof to the carrier frequency of the transmitter leakage signal for selectively amplifying said transmitter leakage signal (VI), a transmitter leakage signal input (TIi) being coupled to the receiver input (Ri) and a transmitter leakage signal output (TIo) being coupled to said transmitter leakage signal input (TIi) thereby forming a negative feed back of the transmitter leakage signal (VI) occurring at the receiver input (Ri).

2. Communication device according to claim 1, **characterized in that** the transmitter leakage signal selective amplifying means (A) comprise a phase splitter (10), an input thereof being coupled to the transmitter output (To), supplying respectively in-phase and quadrature phase components (I, Q) of a transmitter signal to reference signal inputs of first and second demodulators (1, 2), as well as to carrier signal inputs of first and second modulators (7, 8), said first and second demodulators (1, 2) having a transmitter leakage signal input in common with a transmitter leakage signal terminal (TI) of the corrective signal means (C) being coupled to the receiver input (Ri), and outputs being coupled respectively through first and second low pass filters (3, 4) to modulating signal inputs of said first and second modulators (7, 8), an output of said modulators (7, 8) being coupled in common to the transmitter leakage signal inputs of said first and second demodulators (1, 2) and phase inverting means (9) being included in the signal path of the transmitter leakage signal selective amplifying means (A).

3. Communication device according to claim 2, **characterized in that** the first and second modulators (7, 8) each comprise transconductance amplifying means (7'and 7"; 8'and 8") an output thereof being coupled in common to the receiver input (Ri) and the transmitter leakage signal inputs of said first and second demodulators (1, 2).

4. Communication device according to one of claims 1 to 3, **characterized in that** the transmitter leakage signal selective amplifying means (A) provides a non-linear, input signal amplitude dependent amplification of the selected transmitter leakage signal (VI).

5. Communication device according to claim 4, **characterized by** dead zone control means (5, 6) coupled between the first and second low pass filters (3, 4) on the one hand and the first and second modulators (7, 8) on the other hand providing in-phase and quadrature phase components of a baseband modulation signal having a dead zone for amplitude variations of the respective output signals of the first and second lowpass filters (3, 4) within a range between predetermined first and second threshold levels (+Vth, -Vth), the in-phase and quadrature phase components of said baseband modulation signal varying in amplitude with the respective output signals of the first and second lowpass filters (3, 4) for amplitude variations beyond said range.

6. Communication device according to claim 5, **characterized by** said dead zone being determined by the maximum receiver input voltage.

7. Communication device according to one of claims 1 to 6, **characterized by** a duplex filter (DF) having first and second stages (DFT, DFR), the transmitter output (To) being coupled through said first stage (DFT) to the antenna means (ANT), the antenna means (ANT) being coupled through said second stage (DFR) to the receiver input (Ri) and to the transmitter leakage signal terminal (TI) of the corrective signal means (C).

8. Communication device according to one of claims 1 to 7, **characterized by** an attenuator (ATT) coupled between the antenna means (ANT) and the transmitter leakage signal terminal (TI) of the corrective signal means (C).

9. Communication device according to one of claims 5

to 8, **characterized in that** said dead zone control means (5, 6) comprise means for splitting the in-phase and quadrature phase components of the baseband modulation signal into positive and negative in-phase and positive and negative quadrature phase components, the amplitude varying components thereof being supplied to control inputs of variable transconductor amplifiers (7'and 7"; 8'and 8") included in said first and second modulators (7, 8), outputs thereof being coupled through phase inverting means to the transmitter leakage signal terminal (Tl) of the corrective signal means (C).

10. Communication device according to one of claims 5 to 8, **characterized in that** said dead zone control means (5, 6) comprise first and second in-phase signal splitters and first and second quadrature phase signal splitters for splitting said dead zone in-phase and quadrature phase components of the baseband modulation into positive and negative in-phase and positive and negative quadrature phase components, said positive, respectively negative, components being supplied to control inputs of first variable transconductor amplifiers (7', 8') of the first and second modulators (7, 8), respectively through first and second phase inverting means to second variable transconductor amplifiers (7", 8") of the first and second modulators (7, 8), outputs of said first variable transconductor amplifiers (7', 8') and outputs of said second variable transconductor amplifiers (7", 8") through third and fourth phase inverting means being coupled to the transmitter leakage signal terminal (Tl) of the corrective signal means (C).

Patentansprüche

1. Ein Nachrichtengerät, das einen Sender (T) und einen Empfänger (R) enthält, gekoppelt an eine Antennenvorrichtung (ANT) über einen Senderausgang (To) beziehungsweise einen Empfängereingang (Ri), und eine zum Verringern eines Sender-Streusignals (Vl) am Empfängereingang (Ri) angeordnete Korrektursignalvorrichtung (C), und die ausgestattet ist mit einem Sendersignalreferenzeingang (Tri), der an den Senderausgang (To) gekoppelt ist, **dadurch gekennzeichnet, dass** die Korrektursignalvorrichtung (C) eine sender-streusignalselektive Verstärkervorrichtung (A) einschließlich einer frequenzgesteuerten Filteranordnung enthält, die das Senderausgangssignal am Sendersignalreferenzeingang (Tri) benutzt, um dessen Resonanzfrequenz zur Trägerfrequenz des Sender-Streusignals zur selektiven Verstärkung des besagten Sender-Streusignals (Vl) gleichzurichten, wobei ein Sender-Streusignaleingang (Tli) gekoppelt ist an den Empfängereingang (Ri) und ein Sender-Streusignalausgang (Tlo) gekoppelt ist an den besagten Sender-Streusignaleingang (Tli), wodurch eine negative Rückkoppelung des am Empfängereingang (Ri) auftretenden Sender-Streusignals (Vl) gebildet wird.

2. Ein Nachrichtengerät gemäß Patentanspruch 1, **dadurch gekennzeichnet, dass** die sender-streusignalselektive Verstärkervorrichtung (A) einen Phasenteiler (10) enthält, dessen einer Eingang an den Senderausgang (To) gekoppelt ist und der Inphase-beziehungsweise Quadraturphasekomponenten (I, Q) eines Sendersignals an die Referenzsignaleingänge des ersten und zweiten Demodulators (1, 2), und an Trägersignaleingänge des ersten und zweiten Modulators (7, 8) speist, wobei besagter erster und zweiter Demodulator (1, 2) einen Sender-Streusignaleingang gemeinsam haben mit einem Sender-Streusignalanschluss (Tl) der Korrektursignalvorrichtung (C), die an den Empfängereingang (Ri) gekoppelt ist, und Ausgänge, die durch den ersten und zweiten Tiefpassfilter (3, 4) an Modulationssignaleingänge des besagten ersten und zweiten Modulators (7, 8) gekoppelt sind, wobei ein Ausgang der besagten Modulatoren (7, 8) im Gleichtakt an die Sender-Streusignaleingänge des besagten ersten und zweiten Demodulators (1, 2) gekoppelt ist und eine Phasenumkehrvorrichtung (9) im Signalpfad der sender-streusignalselektiven Verstärkungsvorrichtung (A) eingeschlossen ist.

3. Ein Nachrichtengerät gemäß Patentanspruch 2, **dadurch gekennzeichnet, dass** der erste und zweite Modulator (7, 8) jeweils eine Transkonduktanzverstärkungsvorrichtung (7' und 7"; 8' und 8") enthält, deren einer Ausgang im Gleichtakt gekoppelt ist an den Empfängereingang (Ri) und die Sender-Streusignaleingänge des besagten ersten und zweiten Demodulators (1, 2).

4. Ein Nachrichtengerät gemäß einem der Patentansprüche 1 bis 3, **dadurch gekennzeichnet, dass** die sender-streusignalselektive Verstärkungsvorrichtung (A) eine nicht lineare eingangssignalamplitudenabhängige Verstärkung des gewählten Sender-Streusignals (Vl) zur Verfügung stellt.

5. Ein Nachrichtengerät gemäß Patentanspruch 4, **gekennzeichnet durch** eine Totzonenregelungsvorrichtung (5, 6), die gekoppelt ist zwischen dem ersten und zweiten Tiefpassfilter (3, 4) einerseits und dem ersten und zweiten Modulator (7, 8) andererseits, für die Inphase- und Quadraturphasekomponenten eines Basisbandmodulationssignals sorgend mit einer Totzone für Amplitudenschwankungen der jeweiligen Ausgangssignale des ersten und zweiten Tiefpassfilters (3, 4) innerhalb eines Bereichs zwischen festgelegtem ersten und zweiten Schwellenwert (+Vth, -Vth), wobei die Amplitude der Inphase- und Quadraturphasenkomponenten des besagten Basisbandmodulationssignals bei Amplitudenschwankungen, die über den besagten Bereich hinausgehen, abhängig von dem jeweiligen Ausgangssignal des ersten und zweiten Tiefpassfilters (3, 4) schwankt.

6. Ein Nachrichtengerät gemäß Patentanspruch 5, **gekennzeichnet durch** die besagte Totzone, die von der maximalen Empfängereingangsspannung bestimmt wird.

7. Ein Nachrichtengerät gemäß einem der Patentansprüche 1 bis 6, **gekennzeichnet durch** ein Duplexfilter (DF) mit erster und zweiter Stufe (DFT, DFR), wobei der Senderausgang (To) **durch** die besagte erste Stufe (DFT) an die Antennenvorrichtung (ANT) gekoppelt ist, die Antennenvorrichtung (ANT) **durch** die besagte zweite Stufe (DRF) an den Empfängereingang (Ri) gekoppelt ist und an den Sender-Streusignalanschluss (TI) der Korrektursignalvorrichtung (C).

8. Ein Nachrichtengerät gemäß einem der Patentansprüche 1 bis 7, **gekennzeichnet durch** ein zwischen die Antennenvorrichtung (ANT) und den Sender-Streusignalanschluss (TI) der Korrektursignalvorrichtung (C) gekoppeltes Dämpfungsglied (ATT).

9. Ein Nachrichtengerät gemäß einem der Patentansprüche 5 bis 8, **dadurch gekennzeichnet, dass** die besagte Totzonenregelungsvorrichtung (5, 6) eine Vorrichtung zum Teilen der Inphase- und Quadraturphasekomponenten des Basisbandmodulationssignals in positive und negative Inphase- und positive und negative Quadraturphasekomponenten enthält, wobei die Amplitude schwankt, und deren Komponenten werden gespeist an Regeleingänge variabler Transkonduktorverstärker (7' und 7"; 8' und 8"), die in dem besagten ersten und zweiten Modulator (7, 8) enthalten sind, deren Ausgänge durch eine Phasenumkehrvorrichtung an den Sender-Streusignalanschluss (TI) der Korrektursignalvorrichtung (C) gekoppelt sind.

10. Ein Nachrichtengerät gemäß einem der Patentansprüche 5 bis 8, **dadurch gekennzeichnet, dass** die besagte Totzonenregelungsvorrichtung (5, 6) einen ersten und zweiten Inphase-Signalteiler und einen ersten und zweiten Quadraturphase-Signalteiler zum Teilen der besagten Totzonen-Inphase- und Quadraturphasekomponente der Basisbandmodulation in positive und negative Inphase- und positive und negative Quadraturphasekomponenten enthält, wobei die besagten positiven beziehungsweise negativen Komponenten gespeist werden an Regeleingänge der ersten variablen Transkonduktorverstärker (7', 8') des ersten und zweiten Modulators (7, 8), beziehungsweise durch die erste und zweite Phasenumkehrvorrichtung zu den zweiten variablen Transkonduktorverstärkern (7", 8") des ersten und zweiten Modulators (7, 8), wobei die Ausgänge der besagten ersten variablen Transkonduktorverstärker (7', 8') und Ausgänge der besagten zweiten variablen Transkonduktorverstärker (7", 8") durch die dritte und vierte Phasenumkehrvorrichtung an den Sender-Streusignalanschluss (TI) der Korrektursignalvorrichtung (C) gekoppelt sind.

Revendications

1. Dispositif de communication comprenant un émetteur (T) et un récepteur (R) couplés à des moyens d'antenne (ANT), respectivement par une sortie de l'émetteur (To) et une entrée du récepteur (Ri) ainsi que des moyens correctifs de signal (C) arrangés pour réduire un signal de fuite d'émetteur (Vl) à l'entrée du récepteur (Ri) et pourvus d'une entrée de référence de signal de l'émetteur (Tri) couplée à la sortie de l'émetteur (To), **caractérisé en ce que** les moyens correctifs de signal (C) comprennent des moyens d'amplification sélective de signal de fuite d'émetteur (A), y compris un arrangement de filtre à fréquence contrôlée utilisant le signal de sortie de l'émetteur à l'entrée de référence de signal de l'émetteur (Tri) pour verrouiller la fréquence de résonance de celui-ci à la fréquence porteuse du signal de fuite d'émetteur pour amplifier sélectivement ledit signal de fuite d'émetteur (Vl), une entrée de signal de fuite d'émetteur (Tli) étant couplée à l'entrée du récepteur (Ri) et une sortie de signal de fuite d'émetteur (Tlo) étant couplée à ladite entrée de signal de fuite d'émetteur (Tli), constituant ainsi une rétroaction négative du signal de fuite d'émetteur (Vl) apparaissant à l'entré du récepteur (Ri).

2. Dispositif de communication selon la revendication 1, **caractérisé en ce que** les moyens d'amplification sélective du signal de fuite d'émetteur (A) comprennent un séparateur de phase (10), une entrée de celui-ci étant couplée à la sortie de l'émetteur (To), fournissant respectivement des composants en phase et en quadrature (I,Q) d'un signal d'émetteur à des entrées de signal de référence de démodulateur primaire et secondaire (1,2) ainsi qu'à des entrées de signal porteur de modulateur primaire et secondaire (7,8), lesdits démodulateurs primaire et secondaire (1,2) ayant une entrée de signal de fuite d'émetteur (Tl) en commun avec un terminal de signal de fuite d'émetteur (Ti) des moyens correctifs de signal (C) qui est couplée à l'entrée du récepteur (Ri) et des sorties respectivement couplées à travers un filtre passe-bas primaire et secondaire(3,4) à des entrées de modulation de signal desdits modulateurs primaire et secondaire (7,8), une sortie desdits modulateurs (7,8) étant couplée en commun aux en-

trées de signal de fuite d'émetteur desdits démodulateurs primaire et secondaire (1,2) et des moyens d'inversion de phase (9) étant inclus dans le chemin de signal des moyens d'amplification sélective de signal de fuite d'émetteur (A).

3. Dispositif de communication selon la revendication 2, **caractérisé en ce que** les modulateurs primaire et secondaire (7,8) comprennent chacun des moyens d'amplification de la transconductance (7'et 7" ; 8' et 8") dont une sortie est couplée en commun à l'entrée du récepteur (Ri) et aux entrées de signal de fuite d'émetteur desdits démodulateurs primaire et secondaire (1,2).

4. Dispositif de communication selon l'une des revendications 1 à 3, **caractérisé en ce que** les moyens d'amplification sélective de fuite d'émetteur (A) fournissent une amplification non linéaire du signal de fuite d'émetteur sélectionné (VI), dépendant de l'amplitude du signal d'entrée.

5. Dispositif de communication selon la revendication 4, **caractérisé par** des moyens de contrôle de zone morte (5,6) couplés entre les filtres passe-bas primaire et secondaire d'une part et les modulateurs primaire et secondaire (7,8) d'autre part, fournissant des composants en phase et en quadrature de phase d'un signal de modulation de bande de base ayant une zone morte pour les variations d'amplitude des signaux de sortie respectifs des filtres passe-bas primaire et secondaire (3,4), dans une gamme entre des niveaux seuils primaires et secondaires prédéterminés (+Vth, - Vth), les composants en phase et en quadrature de phase dudit signal de modulation de bande de base variant en amplitude avec les signaux de sortie respectifs des filtres passe-bas primaire et secondaire (3,4) pour les variations d'amplitude allant au-delà de ladite gamme.

6. Dispositif de communication selon la revendication 5, **caractérisé par le fait que** ladite zone morte est déterminée le voltage maximum d'entrée du récepteur.

7. Dispositif de communication selon l'une des revendications 1 à 6, **caractérisé par** un filtre duplex (DF) à niveaux primaire et secondaire (DFT, DFR), la sortie de l'émetteur étant couplée par ledit niveau primaire (DFT) aux moyens d'antenne (ANT), les moyens d'antenne étant couplés par ledit niveau secondaire(DFR) à l'entrée du récepteur (Ri) et au terminal de signal de fuite d'émetteur (TI) des moyens correctifs de signal (C).

8. Dispositif de communication selon l'une des revendications 1 à 7, **caractérisé par** un atténuateur (ATT) couplé entre les moyens d'antenne (ANT) et le terminal de signal de fuite d'émetteur (TI) des moyens correctifs de signal (C).

9. Dispositif de communication selon l'une des revendications de 5 à 8, **caractérisé par le fait que** lesdits moyens de contrôle de zone morte (5,6) comprennent des moyens de séparer les composants en phase et en quadrature de phase du signal de modulation de bande de base en composants positifs et négatifs en phase et composants positifs et négatifs en quadrature de phase, les composants variant en amplitude étant fournis pour contrôler les entrées d'amplificateurs transducteurs variables (7'et 7" ; 8' et 8") inclus dans lesdits modulateurs primaire et secondaire (7,8) les sorties de ceux-ci étant couplées par des moyens d'inversion de phase au terminal du signal de fuite d'émetteur (TI) des moyens correctifs de signal (C).

10. Dispositif de communication selon l'une des revendications 5 à 8, **caractérisé par le fait que** lesdits moyens de contrôle de zone morte (5,6) comprennent des séparateurs primaire et secondaire de signal en phase et des séparateurs primaire et secondaire de signal en quadrature pour répartir les composants en phase et en quadrature de phase de ladite zone morte de modulation de bande de base en composants en phase positifs et négatifs et en composants en quadrature de phase positifs et négatifs, lesdits composants respectivement positifs ou négatifs étant fournis pour contrôler les entrées des amplificateurs transducteurs variables primaires (7', 8') du modulateur primaire et secondaire (7,8) ou à travers des moyens d'inversion de première et seconde phase à des amplificateurs transducteurs variables secondaires (7", 8") des modulateurs primaire et secondaire (7,8) les sorties desdits amplificateurs transducteurs primaires variables (7', 8') et les sorties desdits amplificateurs transducteurs secondaires variables (7", 8") à travers des moyens d'inversion de troisième et quatrième phase qui sont couplés au terminal de signal de fuite d'émetteur (TI) des moyens correctifs de signal (C).

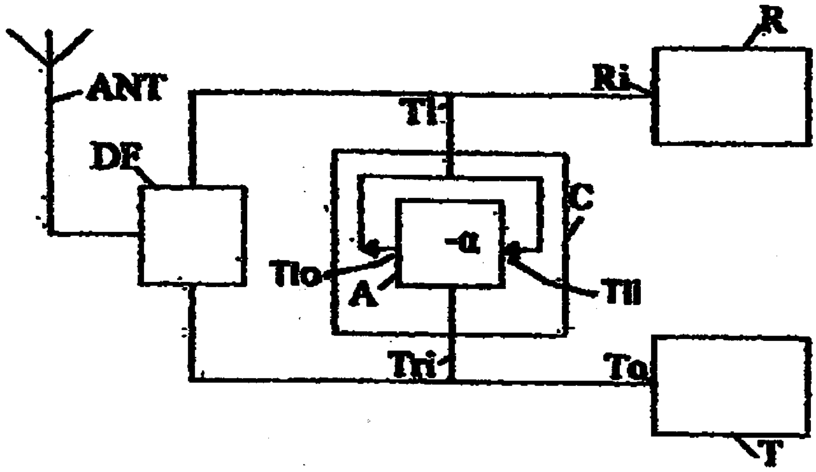

Figure 1

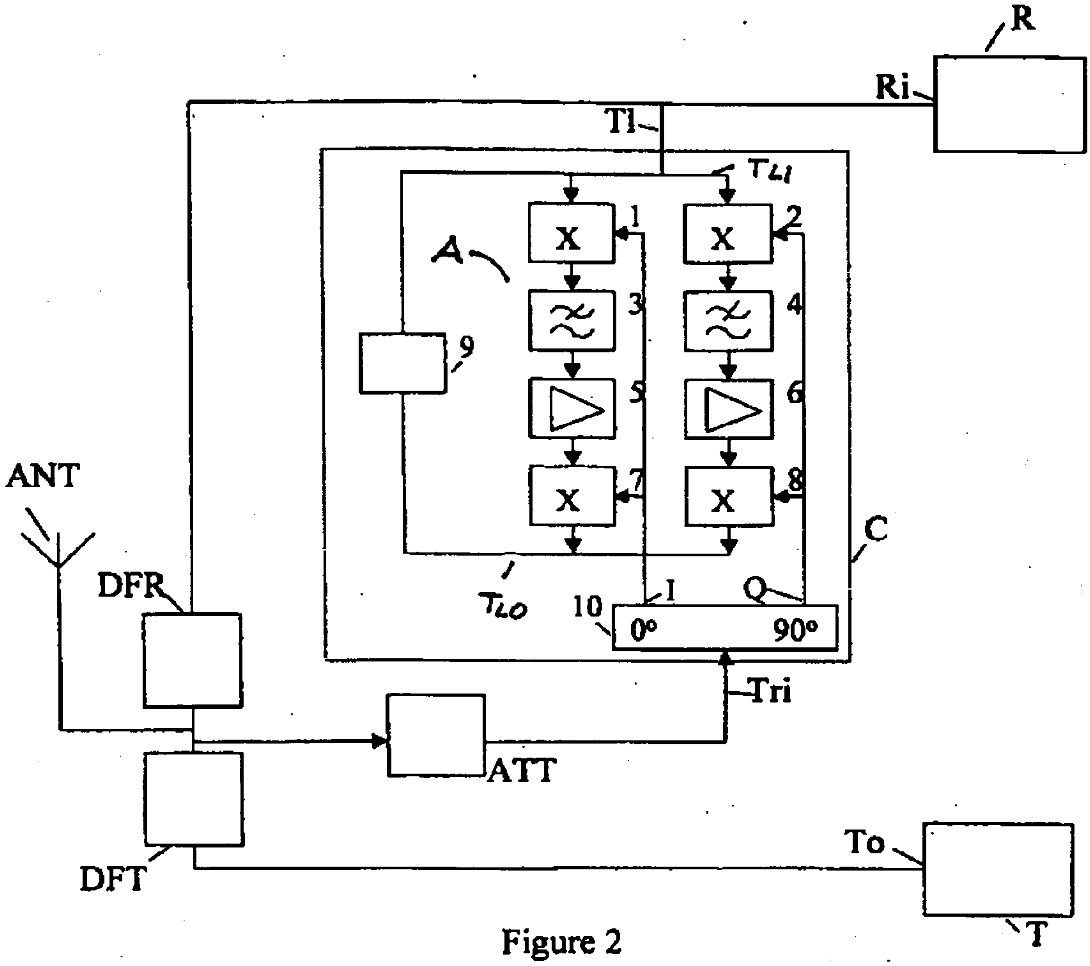

Figure 2

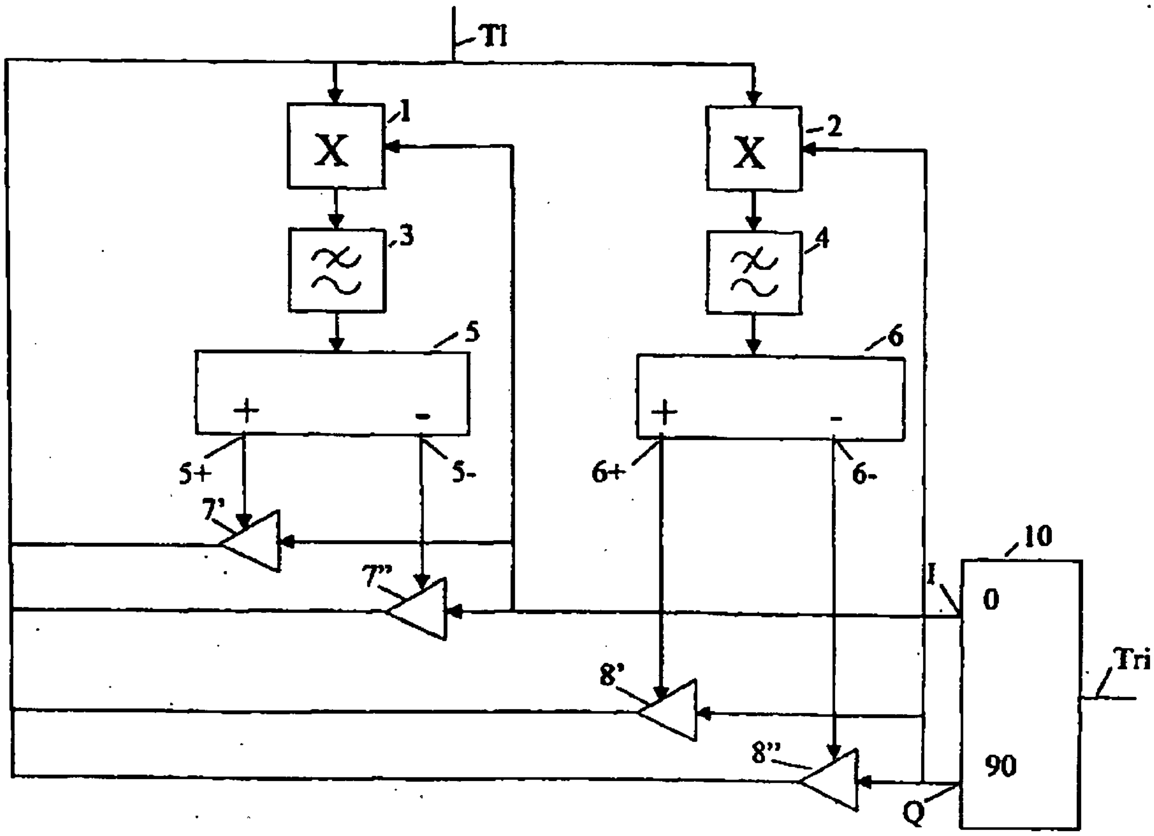

Figure 3

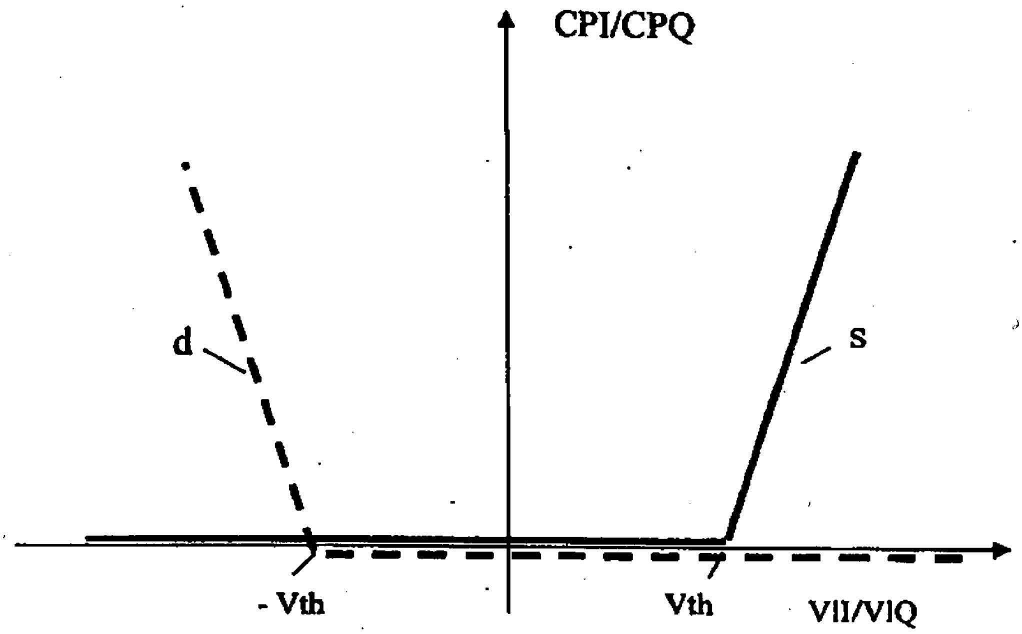

Figure 4

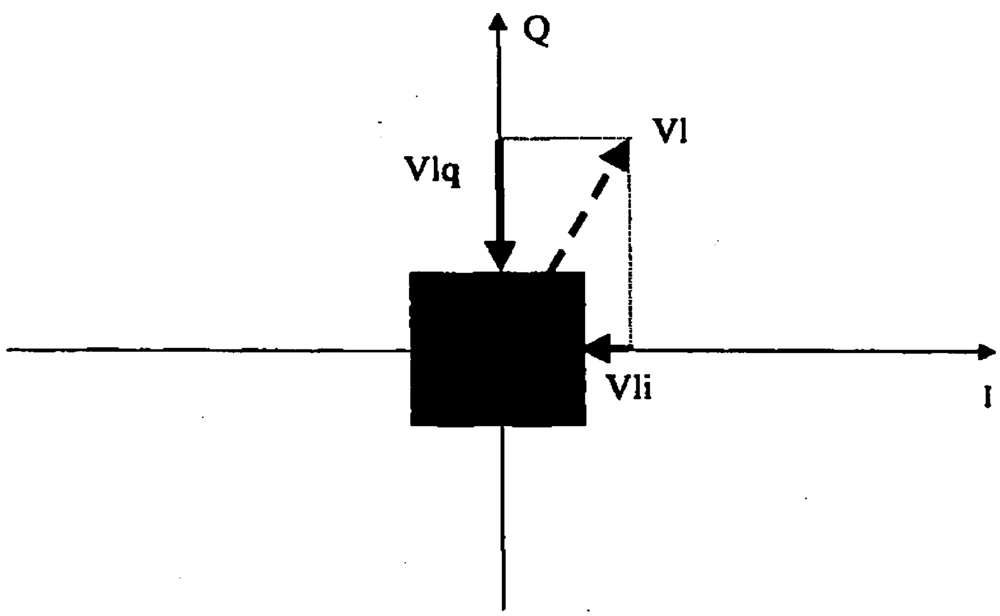

Figure 5

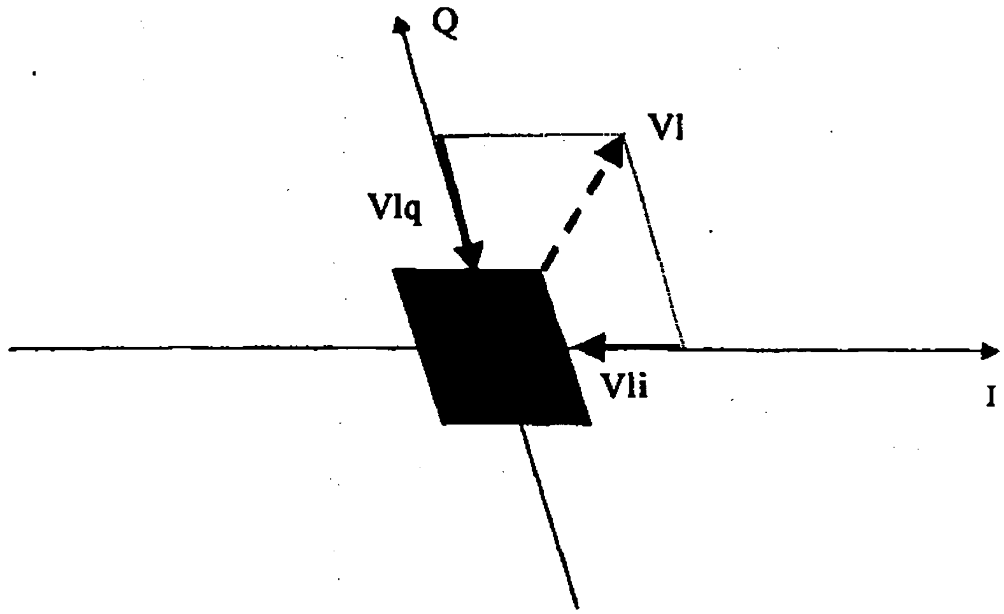

Figure 6