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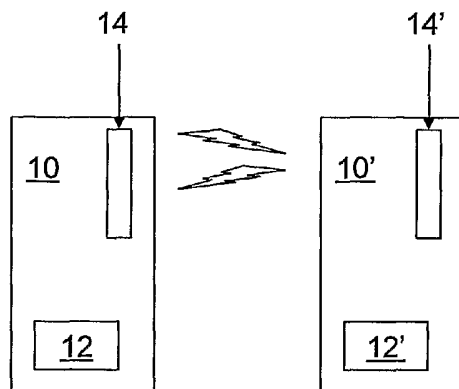
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(54) Title: A METHOD OF, AN ASSEMBLY FOR AND AN APPARATUS FOR COMMUNICATING DATA



(57) Abstract: A device or element for communicating with other elements, which device may emulate both a master and a slave depending on which element it communicates with. All of a plurality of elements may, when not synchronized, periodically transmit electromagnetic pulses and check whether pulses from other elements are detectable. In this manner, a more power economic communication is obtained.



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A METHOD OF, AN ASSEMBLY FOR AND AN APPARATUS FOR COMMUNICATING DATA

The present invention relates to communication, such as wireless communication, between two elements or devices, and in particular to a manner of saving power during periods of time where no data transfer takes place.

- 5 In certain types of communication, it is desired to maintain synchronization between the elements also during periods of time where no data is transferred. Normally, this is obtained by one element being a master element which outputs synchronization pulses for slave elements. The slave elements receive these synchronization pulses and synchronize, via these pulses, to the master.
- 10 Masters and slaves also behave differently at points in time where the elements are not synchronized but are brought to send and receive synchronization pulses. The sync pulses are transmitted by the master. In order to ensure that the pulses are received, the slave actually has to maintain its receiver open for a period of time exceeding the period of the transmission of the synchronization pulses. This is illustrated in Figure 1, wherein Figure 1b
- 15 illustrates a situation where the master and slave are not in sync, whereby the slave needs to maintain its receiver open for a period of time exceeding the period of time between two successive sync pulse transmissions of the master in order to ensure that any sync pulse is received. This requires energy.

Communication is described in e.g. EP-A-1 434 382 and US-A-4 476 527.

- 20 It is an object of the invention to provide communication between two such elements with a lower power requirement in the phase where the two elements are not synchronized.

A first aspect of the invention relates to an element for communicating, such as with another element, the element comprising:

- 25
1. first means for repeating, at least a predetermined number of times: transmitting one or more electromagnetic pulses and checking whether pulses, such as from the other element, are receivable,
 2. means for receiving and acknowledging a pulse received, such as from the other element
 3. means for receiving an acknowledgement, such as from the other element,

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4. means for communicating data, such as with the other element,
5. means for timing operations of the element,
6. means for if a pulse was acknowledged, such as by the other element, and subsequent to the data communication:

5 a. transmitting synchronization pulses on the basis of information retrieved from the timing means,

b. receiving, such as from the other element, acknowledgements of the synchronization pulses, and

10 c. if no acknowledgements have been received, such as from the other element, for a predetermined period of time, activating the first means,

7. means for if a pulse was received, such as from the other element, and subsequent to the data communication:

a. receiving and acknowledging synchronization pulses and controlling the timing means accordingly, and,

15 b. if no synchronization pulses have been received in a predetermined period of time, activating the first means.

Normally, the communication will be with the same (other) element in that this is the most logical manner. However, communication may be performed with a plurality of elements simultaneously.

20 In general, the means 2 is preferably adapted to acknowledge a pulse received from the other element before data transfer and before the two elements are synchronized.

Thus, it is clear that the present device is able to communicate seamlessly with both standard masters outputting sync pulses, which the present element (means 2.) will acknowledge. Subsequent to data transmission, the master will automatically start transmitting sync pulses
25 which means 7. will acknowledge and synchronize to.

Also, the present device may function with a standard slave in that it will start (means 1.) transmitting sync pulses, which the slave will acknowledge. This acknowledgement will be received by means 3. After data transmission, the means 6. will provide the slave with sync pulses.

- 5 Depending on the actual system, the application and other elements therein, the means for activating the first means may be adapted to activate the first means after a predetermined period of time between 1 and 100 seconds, such as 2-10 seconds, preferably around 5 seconds.

- 10 Also, depending on the application, the means for transmitting the synchronization pulses may be adapted to intermittently transmit synchronization pulses and delay for a period of time of 0.1-100 seconds, such as 0.5-5 seconds, preferably around 1 second.

Finally, the first means are adapted to transmit the one or more pulses in a manner so that an identity of the element may be deduced there from. This may provide paired communication as is known.

- 15 A second aspect relates to a computer program for controlling a processor and a transmitter/receiver, the computer program being adapted to:
1. control the transmitter/receiver to repeat, at least a predetermined number of times: transmitting one or more electromagnetic pulses and checking whether pulses, such as from another element, are receivable,
 - 20 2. control the receiver to receive a pulse received, such as from the other element, and the controller to acknowledge receipt of the pulse,
 3. control the receiving means to receive an acknowledgement, such as from the other element,
 4. control the receiving/transmitting means to communicate data, such as with the
25 other element,
 5. if a pulse was acknowledged, such as by the other element, and subsequent to the data communication control the receiving/transmitting means to:

- a. transmit synchronization pulses on the basis of information retrieved from a timing means,
 - b. receive, from the other element, acknowledgements of the synchronization pulses, and
 - 5 c. if no acknowledgements have been received, such as from the other element, for a predetermined period of time, return to step 1,
6. if a pulse was received, such as from the other element, and subsequent to the data communication control the receiving/transmitting means to:
 - 10 a. receive and acknowledge synchronization pulses and controlling a timing means accordingly, and,
 - b. if no synchronization pulses have been received in a predetermined period of time, return to step 1.

Also, the invention relates to a computer readable data carrier loaded with the above
15 computer program.

In a third aspect, the invention relates to a method of two elements communicating, the method comprising:

- 20 1. the elements initially each repeats, at least a predetermined number of times: transmitting one or more electromagnetic pulses and checking whether pulses, such as from other elements, are receivable,
2. subsequent to step 1, a first element of the two elements receives a pulse from a second element, being the other of the two elements, and acknowledges the pulse,
- 25 3. subsequent to step 2, the first element communicates data with the second element,
4. the second element, subsequent to step 3:

- a. transmitting synchronization pulses on the basis of information retrieved from a timing means of the second element,
 - b. receiving, from the first element, acknowledgements of the synchronization pulses, and
 - 5 c. if no acknowledgements have been received from the first element for a predetermined period of time, returning to step 1,
5. the first element, subsequent to step 3:
- a. receiving and acknowledging synchronization pulses from the second element and controlling a timing means of the first element accordingly,
 - 10 and,
 - b. if no synchronization pulses have been received in a predetermined period of time, returning to step 1.

Step 1 is novel in that both elements transmit pulses and "listen" for pulses from other elements. Normally, a slave will only listen.

- 15 The present method may be carried out by two elements according to the first aspect or one element of the first aspect and a normal master.

From the above step 1, a lower power consumption may be obtained especially if a time delay is provided between each set of pulse transmission and listening. In fact, in order for the two elements to better be able to detect the other's pulses, preferably step 1, in both
20 elements, is performed so that the timing of transmission of the pulses is not periodic – such as is randomized within predetermined limits. In that manner, it is prevented that the two elements keep transmitting pulses at the same points of time and listen at the same points in time.

- 25 Preferably, step 1 is maintained until step 2 takes place, that is, until one element detects or receives a synchronization pulse from the other element.

The step of checking whether pulses are receivable normally would entail operating a receiver adapted to receive pulses if such are present.

If the method is carried out e.g. by two elements according to the first aspect, the element first detecting the synchronization pulse of the other takes one "part" or role in the communication in that its actions from detection of the synchronization pulse(s) and further on will be different from the part receiving the acknowledgement of the received pulse. It should be noted that this distribution of roles may be changed after these elements have been out of sync and re-synchronize.

The actual data transfer may be a standard data transfer, and any or both of the elements may transmit data.

Subsequent to step 3, a mode is entered where the second element, also called the master (a standard master or an element according to the first aspect), outputs synchronization pulses controlled by a timing means thereof and the first element, also called the slave, receives these synchronization pulses and "locks" its own timing means to these pulses. Normally, the slave will acknowledge each synchronization pulse.

This synchronization enables the slave to only "listen" (such as operate a receiver) in a time interval around an expected time of receipt of a sync pulse, the size of the time interval depending on a precision of the timing means of the slave. This is illustrated in Figure 1a in which it is seen that the receiver is open only a small period of time around the expected point in time of transmission of the sync pulse.

In this manner, if further data is to be transmitted, the two elements are in synchronism, and the data transfer may commence. If, however, no sync pulses or acknowledgements are received, such as if one element is turned off or malfunctions or if the elements are brought too far from each other, the elements will return to the initial search phase (step 1).

Preferably, the predetermined period of time during which a sync pulse or an acknowledgement should be received in order for the elements to not return to step 1, is between 1 and 100 seconds, such as 2-10 seconds. This will depend on the actual type of system and the elements used. In medical devices and in systems in which a certain delay of communication may be accepted, a predetermined time of 5 seconds may be chosen.

The synchronization taking place in steps 4 and 5 may also be adapted to any suitable elements, such as the precision of the timing means of the elements. High precision timing means allow a larger period of time between synchronizations compared to lower precision timing means – or the slave may open its receiver during a narrower period of time and still receive the next sync pulse. In the preferred embodiment, step 4. a. comprises intermittently transmitting synchronization pulses and delaying for a period of time of 0.1-100 seconds,

such as 0.5-5 seconds, preferably around 1 second. The actual information from the timing means may be pulses or other signals output equidistantly in time or with another predetermined, known or determinable pattern, but any type of information (such as how many pulses of a clocking device should elapse before outputting a pulse) may be used.

- 5 Any type of pulses, such as synchronization pulses, may be used. The communication may be wireless, so that the pulses may be radio wave pulses or radiation pulses (NIR, IR, UV, visible). The communication, alternatively, may be performed over electrical conductors or in optical guides.

- 10 The pulses may be simple, single pulses or may be a series of pulses. The pulses may not comprise other information than their presence, or information may be provided in the pulses. In one embodiment, however, step 1 comprises, for each element, transmitting the one or more pulses in a manner so that an identity of the element may be deduced therefrom. In this manner, acknowledgements need only be transmitted to elements with which an element is paired. This type of situation may be seen in e.g. Bluetooth communication.

- 15 An interesting embodiment is one further comprising a third element, the first element performing any of steps 2-5 with the second element and simultaneously communicates with the third element performing any of the steps:

- 20 1. the first and third elements initially each repeats, at least a predetermined number of times: transmitting one or more electromagnetic pulses and checking whether pulses, such as from other elements, are receivable,

2. one of the first and third elements receives a pulse from another of the first and third elements and acknowledges the pulse,

3. subsequent to step 2, the one element communicates data with the other element,

- 25 4. the other element, subsequent to step 3:

- a. transmitting synchronization pulses on the basis of information retrieved from a timing means of the other element,

- b. receiving, from the one element, acknowledgements of the synchronization pulses, and

- c. if no acknowledgements have been received from the one element for a predetermined period of time, returning to step 1,

5. the one element, subsequent to step 3:

- a. receiving and acknowledging synchronization pulses from the other element and controlling a timing means of the one element accordingly, and,
- b. if no synchronization pulses have been received in a predetermined period of time, returning to step 1.

10 This simultaneous communication with two elements may be performed by multitasking a processor and receiver/transmitter or providing multiple processors/receivers/transmitters. Any of the steps 1-5 may be performed in the communication with one element independently of the step performed with another element.

15 In fact, the communication between the first element and the second element and between the first element and the third element may be carried out on a single frequency, each of the first, second, and third elements then retransmitting data or pulses transmitted, if it is determined that another of the elements transmitted data simultaneously. Preferably, the retransmission is carried out after a randomly determined delay so that it is ensured that two elements will not keep transmitting and receiving at the same points in time and thereby not communicate with each other.

20 In this respect, it should be noted that an element being a standard slave or master device may also be used for communicating with the elements in that the elements may emulate both a slave and a master. This is described in more detail above.

In a last aspect, the invention relates to an assembly comprising two elements adapted to communicate with each other, wherein:

- 25 1. each of the two elements each comprises first means for repeatedly, at least a predetermined number of times: transmitting one or more electromagnetic pulses and checking whether pulses, such as from other elements, are receivable,
- 2. a first element of the two elements comprises means for receiving a pulse from a second element being the other of the two elements and acknowledging the pulse,

3. the two elements comprise means for communicating data with each other,
4. the two elements each comprises a timing means
5. the second element comprises means for, subsequent to the data communication:

- a. transmitting synchronization pulses on the basis of information retrieved from the timing means of the second element,
- b. receiving, from the first element, acknowledgements of the synchronization pulses, and
- c. if no acknowledgements have been received from the first element for a predetermined period of time, activating the first means,

6. the first element comprises means for, subsequent to the data communication:

- a. receiving and acknowledging synchronization pulses from the second element and controlling the timing means of the first element accordingly, and,
- b. if no synchronization pulses have been received in a predetermined period of time, activating the first means.

Again, normally, the means for checking whether pulses are receivable will be a receiver adapted to receive any pulses receivable.

Normally, the means for activating the first means are adapted to activate the first means after predetermined period of time between 1 and 100 seconds, such as 2-10 seconds, preferably, in certain applications, around 5 seconds. This period of time is the period of time allowed to elapse from a last received sync or acknowledgement and to the initial search is again started.

As mentioned above, the means for transmitting the synchronization pulses may be adapted to intermittently transmit synchronization pulses and delay for a period of time of 0.1-100 seconds, such as 0.5-5 seconds, preferably around 1 second.

In a number of applications, the first means are adapted to transmit the one or more pulses in a manner so that an identity of the element may be deduced there from.

However, the means for transmitting and receiving pulses may be adapted to transmit and receive any type of pulse, any number of pulses and pulses with or without information.

- 5 In a preferred embodiment, the assembly further comprises a third element comprising:
1. first means for repeatedly, at least a predetermined number of times:
transmitting one or more electromagnetic pulses and checking whether pulses,
such as from other elements, are receivable,
 2. means for receiving a pulse from another element and acknowledging the pulse,
 - 10 3. means for communicating data with another element,
 4. a timing means,
 5. means for, subsequent to the data communication:
 - a. transmitting synchronization pulses on the basis of information retrieved
from the timing means,
 - 15 b. receiving, from another element, acknowledgements of the
synchronization pulses, and
 - c. if no acknowledgements have been received from the first element for a
predetermined period of time, activating the first means, and
 6. means for, subsequent to the data communication:
 - 20 a. receiving and acknowledging synchronization pulses from another element
and controlling the timing means accordingly, and,
 - b. if no synchronization pulses have been received in a predetermined period
of time, activating the first means.

where the first element is adapted to communicate simultaneously with the second element and the third element.

Preferably, the communication between the first element and the second element and between the first element and the third element is carried out on a single frequency, each of
5 the first, second, and third elements retransmitting data or pulses transmitted, if it is determined that another of the elements transmitted data simultaneously. Also, the retransmission preferably is carried out after a randomly determined delay.

In the following, the invention will be described with reference to the drawing, wherein:

- 10 - Figure 1 illustrates synchronization between a master and a slave when in sync or out of sync and
- Figure 2 is an overall illustration of a preferred embodiment.

Standard synchronization between master and slave is illustrated in Figure 1. Figure 1b illustrates the situation in which the elements are not in sync. In this situation, the master will transmit sync pulses periodically with a fixed period. In order to ensure detection of any
15 sync pulses, the slave has to keep its receiver open for a period of time exceeding this period.

In figure 1b, the two elements are synchronized. This seen by the slave only opening the receiver around the point in time where the sync pulses are expected. The transmission of sync pulses and the opening of the receiver are controlled by timers or clocks of the
20 individual elements.

In Figure 2, two elements 10 and 10' are illustrated adapted to communicate data wirelessly between each other. Naturally, this communication could also be performed over electrical conductors or light guides.

In the present embodiment, the two elements have the same functionality, which is to
25 initially attempt synchronization as a standard master device, i.e. to output sync pulses and then listen for acknowledgements from other elements.

Preferably, the elements are paired in the known sense, where only a device 10' paired with the device 10 will acknowledge the receipt of sync pulses from that device 10. This, however, is not required.

When the device 10' receives a sync pulse from the device 10, it will acknowledge this pulse to the device 10, where after data communication may commence in the known manner.

Subsequent to the data communication, the two elements will maintain synchronization so as to stay capable of communicating. This synchronization is as illustrated in Figure 1a.

- 5 This controlling of the timing means may depend on the actual type of timing means. If the clock of the element is a crystal-based clock, a larger period of time may elapse between the sync pulses than if it was based on an RC-circuit.

10 The reason for maintaining the two timing circuits in sync is simply to reduce power consumption. When knowing approximately when the next sync pulse will be transmitted, the receiving element (slave) may wait until close thereto to open its receiver, whereby power is saved.

15 The two elements may e.g. be removed so far from each other that one element can no longer receive the sync pulses or acknowledgement pulses of the other – or one element may be turned off or malfunction, where after both elements will return to the initial mode of repeating sync pulse transmission followed by a period of time where the element listens for acknowledgement pulses from other elements followed by a power saving delay.

20 The difference between the present elements and standard elements for wireless communication is the fact that the present elements are both adapted to act as masters (transmit sync signals initially) and subsequently convert to the slave role, depending on which element "heard" the other first. Thereafter and until communication/synchronization is ended, this role distribution is maintained.

Presently, the element 10 first receiving a sync pulse from the other element 10' will take the role of the master.

25 It is interesting to note that the present elements will function flawlessly with standard master or slave elements in that, if a normal master element was to communicate with the element 10, this master will not acknowledge the receipt of sync pulses transmitted by the element 10. Thus, the element 10 will receive the sync pulses from the master, acknowledge these and thereafter take the role of the slave. The master will therefore see no difference in communicating with a normal slave or an element according to this embodiment "acting as a
30 slave".

If the element 10 was to communicate with a normal slave, the slave will acknowledge the sync pulses transmitted by the element 10, which thereafter takes the role of the master. Thereafter, the data communication and synchronization may be performed as in the prior art.

- 5 In fact, an element of this type may be used in an application in which the power supply is limited, such as when battery operated. In that situation, the element may be hardwired to not take the role of the slave in that this operation is more power requiring than the master operation. Alternatively, the element may monitor the power situation and only block the slave operation when the power available drops below a predetermined level.
- 10 In figure 2, the operation of the element 10 is controlled by a controller 12 which controls a receiver/transmitter 14 adapted to communicate with a receiver/transmitter 14' controlled by a controller 12' of the element 10'.

- Naturally, the means 14 and 14' may be adapted to transmit any type of pulses and using any medium (air, electrical wires, optical conductors). Also, the controller 12 may be adapted
- 15 to control a number of other operations, such as a storing or providing of the data communicated or other operations of the element 10.

- The element 10 may be a medical instrument adapted to derive data from other sources, such as a blood parameter sensor, via the data communication described. The operation of this data derivation as well as the operation of the actual instrument may also be controlled
- 20 by the controller 12 also performing the operation described above.

CLAIMS

1. An element (10,10') for communicating, the element (10,10') comprising:

- 5 1. first means (14,14') for repeating, at least a predetermined number of times:
transmitting one or more electromagnetic pulses and checking whether pulses are
receivable,
2. means (14,14') for receiving and acknowledging a pulse received,
3. means (14,14') for receiving an acknowledgement,
4. means (14,14') for communicating data,
5. means (12,12') for timing operations of the element(10,10'),
- 10 6. means (12,12',14,14') for if a pulse was acknowledged and subsequent to the
data communication:
 - a. transmitting synchronization pulses on the basis of information retrieved
from the timing means,
 - b. receiving acknowledgements of the synchronization pulses, and
 - 15 c. if no acknowledgements have been received for a predetermined period of
time, activating the first means,
7. means (12,12',14,14') for if a pulse was received and subsequent to the data
communication:
 - 20 a. receiving and acknowledging synchronization pulses and controlling the
timing means accordingly, and,
 - b. if no synchronization pulses have been received in a predetermined period
of time, activating the first means.

2. An element according to claim 1, wherein the means for activating the first means is adapted to activate the first means after predetermined period of time between 1 and 100 seconds, such as 2-10 seconds.

5 3. An element according to claim 1 or 2, wherein the means (14,14') for transmitting the synchronization pulses are adapted to intermittently transmit synchronization pulses and delay for a period of time of 0.1-100 seconds, such as 0.5-5 seconds.

4. An element according to any of claims 1-3, wherein the first means (14,14') are adapted to transmit the one or more pulses in a manner so that an identity of the element (10,10') may be deduced there from.

10 5. A computer program for controlling a processor and a transmitter/receiver, the computer program being adapted to:

1. control the transmitter/receiver to repeat, at least a predetermined number of times: transmitting one or more electromagnetic pulses and checking whether pulses are receivable,

15 2. control the receiver to receive a pulse received and the controller to acknowledge receipt of the pulse,

3. control the receiving means to receive an acknowledgement,

4. control the receiving/transmitting means to communicate data,

20 5. if a pulse was acknowledged and subsequent to the data communication control the receiving/transmitting means to:

d. transmit synchronization pulses on the basis of information retrieved from a timing means,

e. receive acknowledgements of the synchronization pulses, and

25 f. if no acknowledgements have been received from the other element for a predetermined period of time, return to step 1,

6. if a pulse was received and subsequent to the data communication control the receiving/transmitting means to:

c. receive and acknowledge synchronization pulses and controlling a timing means accordingly, and,

5 d. if no synchronization pulses have been received in a predetermined period of time, return to step 1.

6. A computer readable data carrier loaded with a computer program according to claim 5.

7. A method of two elements (10,10') communicating, the method comprising:

10 1. the elements (10,10') initially each repeats, at least a predetermined number of times: transmitting one or more electromagnetic pulses and checking whether pulses are receivable,

15 2. subsequent to step 1, a first element(10,10') of the two elements (10,10') receives a pulse from a second element(10,10'), being the other (10,10') of the two elements, and acknowledges the pulse,

3. subsequent to step 2, the first element (10,10') communicates data with the second element(10,10'),

4. the second element(10,10'), subsequent to step 3:

20 a. transmitting synchronization pulses on the basis of information retrieved from a timing means of the second element(10,10'),

b. receiving, from the first element(10,10'), acknowledgements of the synchronization pulses, and

c. if no acknowledgements have been received from the first element (10,10') for a predetermined period of time, returning to step 1,

25 5. the first element(10,10'), subsequent to step 3:

- a. receiving and acknowledging synchronization pulses from the second element (10,10') and controlling a timing means of the first element (10,10') accordingly, and,
- b. if no synchronization pulses have been received in a predetermined period of time, returning to step 1.
- 5
8. A method according to claim 7, wherein the predetermined period of time is between 1 and 100 seconds, such as 2-10 seconds.
9. A method according to claim 7 or 8, wherein step 4. a. comprises intermittently transmitting synchronization pulses and delaying for a period of time of 0.1-100 seconds,
- 10 such as 0.5-5 seconds.
10. A method according to any of claims 7-9, wherein step 1 comprises, for each element(10,10'), transmitting the one or more pulses in a manner so that an identity of the element(10,10') may be deduced there from.
11. A method according to any of claims 7-10, further comprising a third element(10,10'),
- 15 the first element (10,10') performing any of steps 2-5 with the second element (10,10') and simultaneously communicates with the third element (10,10') performing any of the steps:
1. the first and third elements (10,10') initially each repeats, at least a predetermined number of times: transmitting one or more electromagnetic pulses and checking whether pulses are receivable,
 - 20 2. one of the first and third elements (10,10') receives a pulse from another of the first and third elements (10,10') and acknowledges the pulse,
 3. subsequent to step 2, the one element (10,10') communicates data with the other element,
 4. the other element(10,10'), subsequent to step 3:
 - a. transmitting synchronization pulses on the basis of information retrieved
 - 25 from a timing means of the other element(10,10'),

- b. receiving, from the one element(10,10'), acknowledgements of the synchronization pulses, and
- c. if no acknowledgements have been received from the one element (10,10') for a predetermined period of time, returning to step 1,

5 5. the one element(10,10'), subsequent to step 3:

- a. receiving and acknowledging synchronization pulses from the other element (10,10') and controlling a timing means of the one element(10,10') accordingly, and,
- b. if no synchronization pulses have been received in a predetermined period
10 of time, returning to step 1.

12. A method according to claim 11, wherein the communication between the first element (10,10') and the second element (10,10') and between the first element (10,10') and the third element(10,10') is carried out on a single frequency, each of the first, second, and third elements (10,10') retransmitting data or pulses transmitted, if it is determined that
15 another of the elements (10,10') transmitted data simultaneously.

13. A method according to claim 12, wherein the retransmission is carried out after a randomly determined delay.

14. An assembly comprising two elements (10,10') adapted to communicate with each other, wherein:

- 20 1. each of the two elements (10,10') each comprises first means (14,14') for repeatedly, at least a predetermined number of times: transmitting one or more electromagnetic pulses and checking whether pulses are receivable,
- 2. a first element (10,10') of the two elements (10,10') comprises means (14,14') for receiving a pulse from a second element (10,10') being the other of the two
25 elements (10,10') and acknowledging the pulse,
- 3. the two elements (10,10') comprise means for communicating data with each other,

4. the two elements (10,10') each comprises a timing means
5. the second element (10,10') comprises means (12,12',14,14') for, subsequent to the data communication:

- a. transmitting synchronization pulses on the basis of information retrieved from the timing means of the second element(10,10'),
- b. receiving, from the first element(10,10'), acknowledgements of the synchronization pulses, and
- c. if no acknowledgements have been received from the first element (10,10') for a predetermined period of time, activating the first means,

6. the first element (10,10') comprises means (12,12',14,14') for, subsequent to the data communication:

- a. receiving and acknowledging synchronization pulses from the second element (10,10') and controlling the timing means of the first element (10,10') accordingly, and,

- b. if no synchronization pulses have been received in a predetermined period of time, activating the first means.

15. An assembly according to claim 14, wherein the means (12,12') for activating the first means (14,14') is adapted to activate the first means after predetermined period of time between 1 and 100 seconds, such as 2-10 seconds.

16. An assembly according to claim 14 or 15, wherein the means (14,14') for transmitting the synchronization pulses are adapted to intermittently transmit synchronization pulses and delay for a period of time of 0.1-100 seconds, such as 0.5-5 seconds.

17. An assembly according to any of claims 14-16, wherein the first means (14,14') are adapted to transmit the one or more pulses in a manner so that an identity of the element (10,10') may be deduced there from.

18. An assembly according to any of claims 14-17, further comprising a third element (10,10') comprising:

1. first means (14,14') for repeatedly, at least a predetermined number of times:
transmitting one or more electromagnetic pulses and checking whether pulses are
receivable,
2. means (14,14') for receiving a pulse from another element (10,10') and
acknowledging the pulse,
3. means for communicating data with another element(10,10'),
4. a timing means,
5. means(12,12',14,14') for, subsequent to the data communication:
 - a. transmitting synchronization pulses on the basis of information retrieved
from the timing means,
 - b. receiving, from another element(10,10'), acknowledgements of the
synchronization pulses, and
 - c. if no acknowledgements have been received from the first element
(10,10') for a predetermined period of time, activating the first means,
and
6. means (12,12',14,14') for, subsequent to the data communication:
 - a. receiving and acknowledging synchronization pulses from another element
(10,10') and controlling the timing means accordingly, and,
 - b. if no synchronization pulses have been received in a predetermined period
of time, activating the first means.

where the first element (10,10') is adapted to communicate simultaneously with the second element (10,10') and the third element(10,10').

19. An assembly according to claim 118, wherein the communication between the first element (10,10') and the second element (10,10') and between the first element (10,10') and the third element(10,10') is carried out on a single frequency, each of the first, second,

and third elements (10,10') retransmitting data or pulses transmitted, if it is determined that another of the elements(10,10') transmitted data simultaneously.

20. An assembly according to claim 19, wherein the retransmission is carried out after a randomly determined delay.

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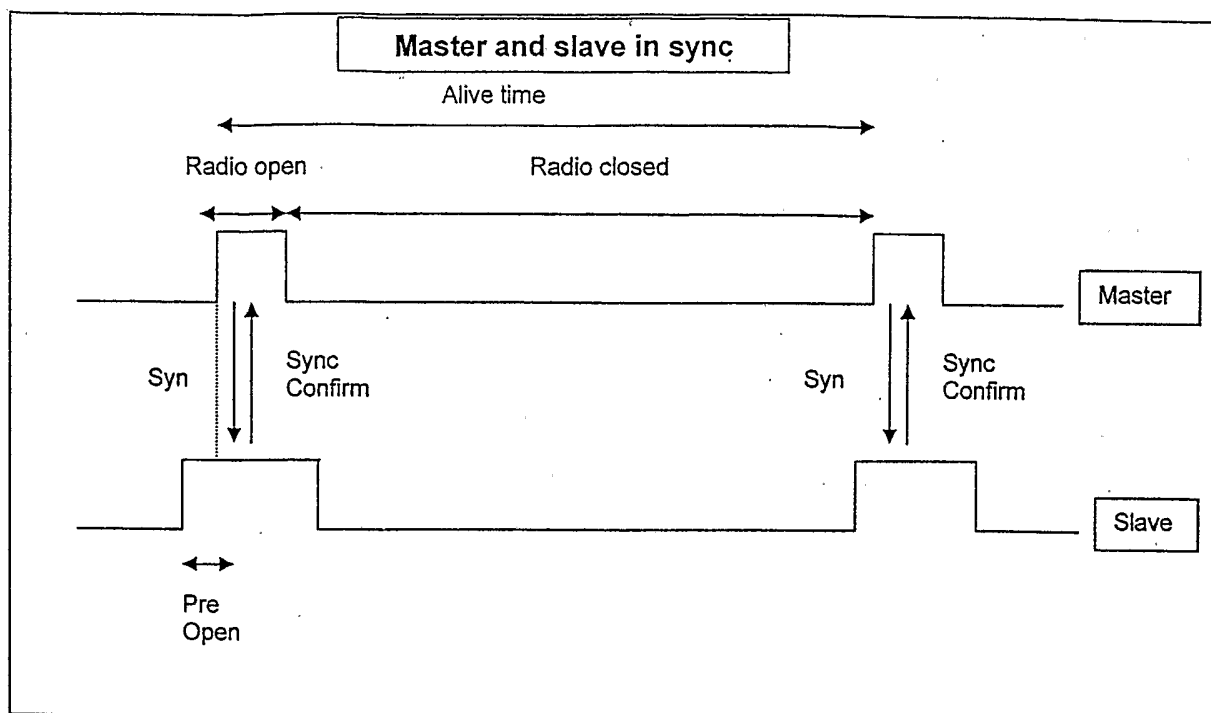


Fig. 1a

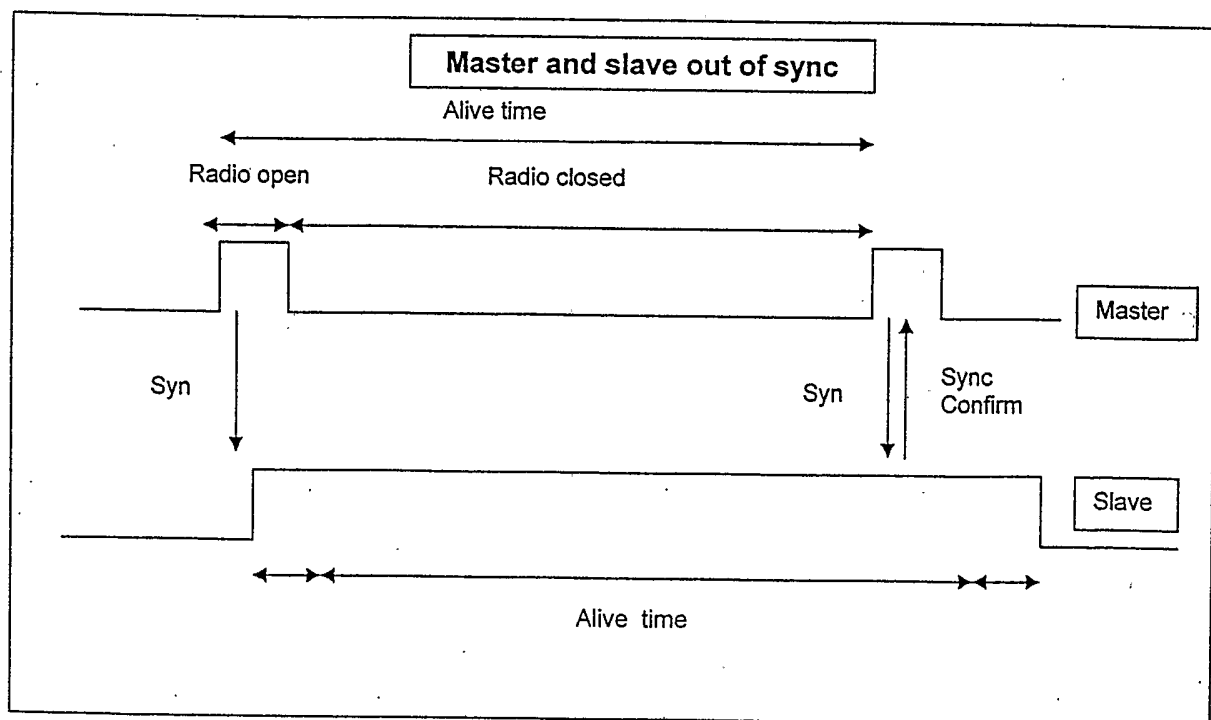


Fig. 1b

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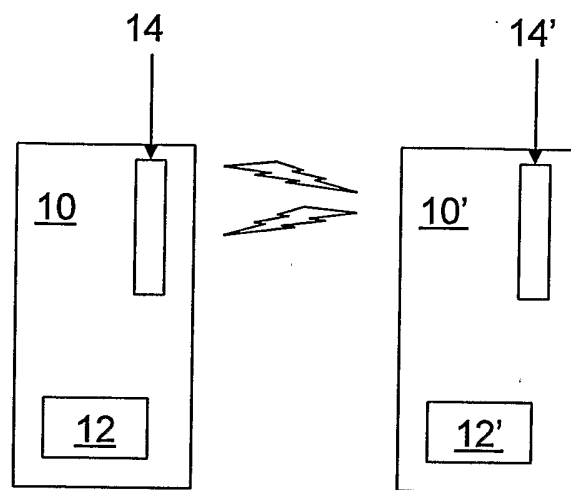


Fig. 2

INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP2005/011462

A. CLASSIFICATION OF SUBJECT MATTER
H04B1/16

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)
H04B

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, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1 434 382 A (HITACHI, LTD; HITACHI CAR ENGINEERING CO., LTD) 30 June 2004 (2004-06-30) abstract; claim 1; figure 1 -----	1-20
A	US 4 476 527 A (CLAYTON, IV ET AL) 9 October 1984 (1984-10-09) abstract; claim 1; figure 1 -----	1-20

☐ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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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

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

& document member of the same patent family

Date of the actual completion of the international search

18 January 2006

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24/01/2006

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP2005/011462

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