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(54) Bus master device for a hazard alarming system and a hazard alarming system using the same

(57) The invention concerns a bus master device for controlling the operation of at least one hazard alarming device (3) comprising: a first interface (15) for connecting a first bus (1) coupled with the least one hazard alarming device (3); a second interface (5) for connecting a second bus (7) coupled with a central control device (9); and an internal time determining device (11) for determining a local time signal to be used to control an alarm operation of the at least one hazard alarming device (3); characterized by comprising synchronisation means (13) for receiving a master time signal from the central control device (9) via the second bus (7) and for controlling the local time signal based on the master time signal.

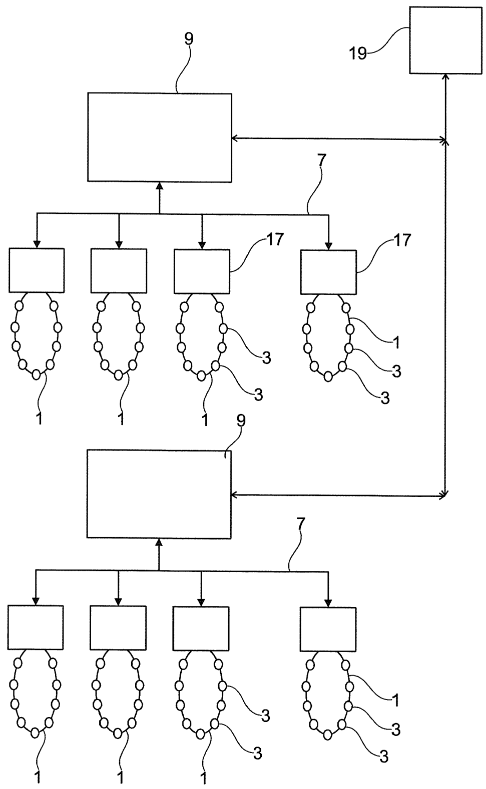

Fig. 1

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Description

[0001] The present invention relates to a bus master device for a hazard alarming system and a hazard alarming system using the bus master device.

[0002] Hazard alarming systems are used for detecting and communicating a hazardous situation, like a fire, to persons within a building. These systems usually comprise a plurality of hazard alarming devices like flash lights or speakers for communicating the hazardous situation and/or other devices, like smoke detectors, fire detectors, burglar detectors and so on coupled to a common bus.

[0003] The hazard alarming devices are coupled to the bus supplying control signals and optionally power to the hazard alarming devices and/or other devices. The bus is additionally coupled to a bus master device supplying the bus with the control signals and/or the power and for receiving information from the hazard alarming devices and/or other devices. The information provided to the bus master device from the hazard alarming devices and/or other devices can include e.g. information regarding the operation failure conditions, like short circuits.

[0004] The system can be formed so as to comprise a plurality of bus master devices, each one with his one bus and his own plurality of hazard alarming devices and/or other devices. In this case the bus master devices are connected via a second bus with a common central control device, which is used for a central control of the system and for informing a user about the actual configuration and status of the system.

[0005] DE 10 2005 062 129 A1 discloses a system, where a plurality of hazard detecting devices are shown, which are connected to respective buses and respective bus master devices, which in turn are connected via a second bus to a central control unit.

[0006] In some cases it might occur that the same spatial area is exposed to an emission of sound or light from hazard alarming devices connected to different bus master devices. A user observing the sound or light might feel uncomfortable in case of receiving deviating signals from the two or more hazard alarming devices at the same time.

[0007] DE 100 00 303 B4 or DE 100 53 525 A1 disclose a system comprising a bus and a plurality of bus members configured to synchronize with a master clock. The aim of these document is to control the communication times of the bus members so as to avoid data collisions, respectively so as to ensure a better use of the bus over the time and therefore a very accurate synchronization is required. These documents are not directed to hazard alarming systems.

[0008] IEEE 1588 PTP (Precision Time Protocol) is a protocol used to synchronize clocks throughout a computer network. On a local area network, it achieves clock accuracy in the submicrosecond range, making it suitable for measurement and control systems. This document is not related to hazard alarming systems, either.

[0009] It is an object to provide a bus master device and a hazard alarming system which can provide a more convenient alarming action for a user.

[0010] This object is achieved by means of the combination of features of present claims 1 and 4. The dependent claims are directed to different advantageous aspects of the invention.

[0011] According to the invention there is provided a master time signal which is distributed to the master bus devices and which is used to synchronize the alarming operation of the hazard alarming devices connected to the respective bus master deice.

[0012] According to an embodiment of the invention the bus master device for controlling the operation of at least one hazard alarming device comprising a first interface for connecting a first bus coupled with the least one hazard alarming device, a second interface for connecting a second bus coupled with a central control device, and an internal time determining device for determining a local time signal to be used to control an alarm operation of the at least one hazard alarming device, wherein the bus master device further comprises synchronisation means for receiving a master time signal from the central control device via the second bus and for controlling the local time signal based on the master time signal.

[0013] According to an embodiment of the invention the synchronisation means is configured to control the local time signal so that upon receiving the master time signal the local time signal is set to the same value as the received master time signal.

[0014] According to an embodiment of the invention the synchronisation means is configured to control the local time signal so that upon receiving the master time signal the internal time determining device is accelerated or delayed.

[0015] According to an embodiment of the invention there is provided a hazard alarming system comprising a central control device for generating a master time signal, a plurality of master bus devices, a plurality of hazard alarming devices, a plurality of first buses coupling hazard alarming devices out of the plurality of hazard alarming devices with respective once of the plurality of master bus devices, and a second bus coupling the plurality of master bus devices and the central control device, wherein at least two of the master bus devices are each formed so as to comprise a first interface for connecting a first bus coupled with the least one hazard alarming device, a second interface for connecting a second bus coupled with a central control device, and an internal time determining device for determining a local time signal to be used to control an alarm operation of the at least one hazard alarming device, wherein the bus master device further comprises synchronisation means for receiving a master time signal from the central control device via the second bus and for controlling the local time signal based on the master time signal.

[0016] According to an embodiment of the invention the hazard alarming system comprises a plurality of second buses coupling respective master bus devices, wherein the central control device is configured to generate the same master time signal for the plurality of second buses.

[0017] According to an embodiment of the invention the plurality of hazard alarming devices includes a plurality of optical alarming devices for emitting flash lights, and the optical alarming devices are coupled with various master bus devices through various first buses.

[0018] In the following different preferred embodiments of the invention will be described with regard to the accompanying drawings, which show:

Fig. 1 an overall view of a hazard alarming system according to an embodiment of the invention; and

Fig. 2 a detailed block diagram of a bus master according to an embodiment of the invention.

[0019] Fig. 1 discloses a hazard alarming system according to a preferred embodiment of the invention. A plurality of first buses 1 are formed as loops connecting a plurality of hazard alarming devices 3 and/or other devices - like smoke detectors or flame detectors - with the respective bus master device 17.

[0020] A typical example of a bus 1 is configured as a to wired bus transmitting both, the power for the operation of the hazard alarming devices as well as the signals, to respectively from the hazard alarming devices.

[0021] The bus 1 is not limited to a loop design, other designs, as a branch line or multiple branch lines connected to the bus master device are possible as well.

[0022] The bus 1 is connecting a plurality of hazard alarming devices 3. Examples of hazard alarming devices are acoustical hazard alarming devices, optical hazard alarming devices or loudspeakers for emitting voice messages. However, the system is not limited to these hazard alarming devices and other suitable means might be implemented, for example combinations of acoustical and optical hazard alarming devices.

[0023] Additionally and as mentioned above the bus might further connect hazard detecting devices, like smoke sensors, flame sensors, gas sensors, cameras, burglar alarm devices and so on. Finally, it is possible to connect relay devices for operating mechanical apparatuses of the surveillance area, like doors, windows or ventilation openings. Finally, the bus 1 is not limited to wire bounded buses, but can include an interface for a wireless transmission, so that individual hazard alarming devices 3 or hazard detecting devices can be installed at remote places, where no wire connection is available.

[0024] Even if not shown in detail, for cases where a hazard alarming device 3 or hazard detecting device has to reach an explosion proof area, it is possible that the bus is divided in galvanic isolated sections.

[0025] The bus 1 is connected with and controlled by a bus master device 17. A typical bus master device 17 comprises a first interface 15 for connecting the first bus 1, which as mentioned above is coupled with at least one hazard alarming device 3.

[0026] As shown in Fig. 2 the bus master device 17 comprises an internal time determining device 11 for determining a local time signal. This local time signal will be used to control the operation of the at least one hazard alarming device 3 connected through the bus 1 with the bus master device 17.

[0027] According to the present invention the bus master device 17 further comprises a second interface 5 for connecting the bus master device 17 to a second bus 7. Additionally, the bus master device 17 comprises a synchronisation means 13 for receiving a master time signal via the second bus 7 and for controlling the internal time determining device 11 so as to control the local time signal based on the master time signal.

[0028] The second bus can be any kind of bus, like a two wired proprietary field bus, an Ethernet bus, a wireless local area network bus or an optical bus. The second bus is configured to connect a plurality of bus master devices 17 and a central control device 9. The central control device 9 can be either a dedicated central control device 9, as shown in Fig. 1, or can be one of the bus master devices, which by internal setting of the system has been assigned to function as central control device 9.

[0029] The first bus 1 can connect up to 250 bus devices, like hazard alarming devices 3, and might have a communication rate of for example 6250 Bit/SEC like the FlexES® bus of the applicant of the present application and might have a length of up to 3 kilometres using a standard twisted pair of telephone wires.

[0030] The second bus 7 can be for example a CAN-bus having a transmition speed of 1M Bit/SEC and might be configured to connect up to 80 master bus devices 17.

[0031] As shown in Fig. 1 the system has a further top level control, so that a plurality of central control devices 9 are connected with a main control unit 19, an example for that interconnection of the central control devices 9 is implemented under the trademark "ESSERNET®" using dedicated cable and having a transmission speed of for example 500 kBit/SEC. The ESSERNET® allows to connect up to 31 central control devices 9 and a dedicated main control unit 19.

[0032] As described the system in Fig. 1 can cover a large area in a huge building like an airport or a train station with appropriate hazard alarming devices 3.

[0033] In case of an alarm it might happen at any position within the installation that a person will be alarmed by hazard alarming devices 3 connected with different bus masters devices 17, which in turn might be connected with the same or even with different central control units 9. If in this case the hazard alarming devices emit their alarming signals in an un-synchronised manner, it might be difficult or even impossible to correctly identify the alarming signal, and the person, to which the alarm is directed, might be miss leaded.

[0034] Therefore, the present invention proposes to control the operation of the hazard alarming devices 3 so as to operate in a synchronised manner.

[0035] Especially in the case of using optical alarming devices which are driven in a pulsed fashion it is helpful, if these devices are driven with a more or less synchronised clock. Even more important is that the synchronisation should be provided for voice alarming devices or acoustical alarming devices. In this case time differences of 20 ms can be noticed and a voice message transmitted through the hazard alarming devices might be difficult to understand, if the time difference exceeds this limit.

[0036] The present invention suggests to assign a master clock for the system. The master clock will provide a time signal which will be distributed through the network. A special accuracy of the master clock is not required, since any deviation of the master time vis-à-vis the real time will be distributed through the entire system and therefore will not affect the overall operation. In other words, whether a second as determined by a master clock corresponds exactly to one second is not relevant, since deviations of the master time from the real time have no influence on the operation of the system.

[0037] In the preferred embodiment described in Fig. 1 the master clock might be provided by the main control unit 19. The main control unit 19 will transmit a master time signal through a bus 21 connecting the main control unit 19 and the respective central control devices 9. The central control devices 9 will receive the master time signal and use this signal to synchronise their own internal clocks. Thus synchronised internal clocks will be used to send a derived master time signal through the second bus 7 to the individual bus master devices 17. Upon receiving this derived master time signal master time signal the synchronisation means 13 of the respective bus master device 17 will synchronise the internal clock of the bus master device 17 and will use the thus synchronised local time signal for controlling the operation of the hazard alarming devices 3.

[0038] In a preferred embodiment the master time signal of the main control unit might comprise 32 bit, which can represent a counter in steps of milliseconds. The lowest bit, i.e. bit 0, represents 1 millisecond, the next bit, i.e. bit 1, represents 2 milliseconds, the next bit, i.e. bit 2, represents 4 milliseconds... and so on. The main control unit 19 will be configured to send a synchronisation message at regular intervals or at special events transmitting the master time signal to the respective central control devices 9.

[0039] The actual time period between the transmission of two consecutive synchronisation messages depends on the accuracy of the local clocks of the central control devices 9. Typically, with an external resonator, it will be enough to transmit the synchronisation message every 30 seconds.

[0040] In the time period between the two transmissions of the synchronisation message by the main control unit each central control device 9 of each central control device 9 will continue to determine a derived master time signal independently by an appropriate counter within the central control device 9, which will be set by the local clock of the respective the central control device 9. Of course, if the central control devices 9 have high procession clocks a longer time interval between two synchronisation messages will be possible. On the other hand, if the clock of the central control devices 9 is less accurate, a shorter time interval will be necessary.

[0041] Upon synchronising the central control device 9 will have a derived master time signal. Each central control device 9 will upon synchronising the internal clock transmit the derived master time signal though the bus 7 to the bus master devices 17 as a signal of 32 Bit or less.

[0042] If the time required for the synchronisation in the central control devices 9 is larger than one millisecond the derived master time signal will be shorter, for example will have only 29 Bits or 28 Bits and will therefore represent only a signal with an accuracy of 8 milliseconds or 16 milliseconds.

[0043] Upon receiving the derived master time signal the respective bus master devices 17 will synchronise their local clocks and will transmit any operation instructions and control signals to the hazard alarming devices 3 based on the synchronised local time signal.

[0044] For the synchronisation of the clock of a master bus device 17 with the derived master time signal or for the synchronisation of the clock of a central control device 9 with the main master time signal two different approaches will be explained.

[0045] The first approach is a hard synchronisation. The hard synchronisation will be explained for the synchronisation of the derived master time signal with the main master time signal.

[0046] The central control device 9 will upon receiving the main master time signal overwrite the internal counter value with the received value of the main master time signal and will continue the operation based on the new time value. This system has the advantage of achieving a very fast synchronisation of the clocks and can be implemented in a simple manner.

[0047] The same hard synchronisation method can be used for synchronising the clocks of a master bus device 9 with the derived master time signal.

[0048] Noted apart, it is not necessary that the time interval of transmitting synchronisation message between the main control and the central control devices 9 is the same as the time interval used for transmitting a synchronisation message between a central control device 9 and the respective bus master devices 17. These time intervals are independent from each other and should be selected depending on the accuracy of the respective clocks so as to allow a synchronisation of less than 20 milliseconds over the entire system. As mentioned above typically a time interval of 30 seconds for both cases should be possible, so as not to impose a too high load on the transfer allowed on the respective buses.

[0049] As an alternative to the described hard synchronisation a soft synchronisation might be used.

[0050] As described above, in case of a hard synchronisation the count value of the internal clock of a central control device 9 or a bus master device 17 is overwritten. This means that there might be gaps in the series of values taken by the counter of the internal clock or that certain count values may be repeated due to the overwriting.

[0051] However, it might be that such a certain count value, which is skipped due to the hard synchronisation, should be used to trigger an operation of one of the devices. This means, that in worst case an operation of one of the devices will not start or end at all.

[0052] In the case that the certain count value designated for triggering an operation is not skipped, but repeated, the operation will be started twice, which might lead to operation errors of the entire system. This drawback is avoided by the soft synchronisation method in which case the synchronisation is done by accelerating or slowing down the local clocks.

[0053] For doing so the receiving device, that is either the central control device 9 receiving the main master time signal from the main control unit 19, or the master bus device 17, receiving the derived master time signal from the central control device 9, will compare the local time signal and the received master time signal.

[0054] If the comparison shows that the two signals match no action will be required.

[0055] In case comparison shows that that the two signals deviate from each other the local time will either be accelerated or slowed down.

[0056] Since the synchronisation is only done in values of e.g. 1 ms, which is far larger than the operation step of the typical internal clock of a CPU, it is easy to either accelerate or slow down the internal clock in units of 1 ms. Depending on the extent of the slowing down or accelerating of the internal clock after a couple of synchronisation messages the synchronisation of two time signals, i.e. the local time signal and the master time signal, will have been reached.

[0057] In an preferred embodiment the extent of acceleration or slowing down of the internal clock is selected depending on the actual difference between the master time signal and the local time signal. If the difference is large the extent of acceleration/slowing down is selected to be large, whereas, if the difference is small, the amount of acceleration/ slowing down is selected to be small. This can be done in 3 different steps, for example. However any other number of steps might be selected at need.

[0058] The advantage of the soft synchronisation is that the time signal, either the derived master time signal or the local time signal, will by a continuous count assuming each value without gaps or repetitions.

[0059] Finally, it is possible to combine both methods for synchronisation, i.e. the hard synchronisation and the soft synchronisation. For example it will be possible to perform the hard synchronisation once, for example during the start up of the system, or once a day, and after the hard synchronisation to keep the times signals matching to each other by means of a soft synchronisation.

[0060] The system allows a high degree of flexibility in so far as that it is not required to have the same synchronisation level in each part thereof. For example a bus device, like a hazard alarming device 3 might take only 8 or 16 bits out of the 32 bit signal of the time signal distributed by the bus master device 17. The 8 bits might correspond to a time of 8 milliseconds, 16 milliseconds and up to 2048 milliseconds. This is preferred if the hazard alarming device 3 connected to the bus 1 makes use a simple 8 bit controller and it is not necessary to archive a precision which goes beyond the 8 ms provided by this clock.

[0061] According to the invention all the hazard alarming devices 3 will be synchronised with the corresponding accuracy of 20 ms, regardless whether they are connected with the same bus 1 or connected to different buses 1, which in turn might be connected to different central control devices 9.

[0062] A a user will always view and hear the alarm message in a synchronised manner, even if he observes signals emitted from a plurality of hazard alarming devices 3 connected to different busses 1 within the system.

[0063] The invention is not limited to a 32 bit time signal, neither for the main master time signal nor for the derived master time signal nor for the local time signal. If desired a 64 bit time signal or a 16 bit time signal might be used instead.

[0064] Furthermore, the invention is not limited to time intervals of 30 seconds between synchronisation messages. Different time intervals can be used at the different levels.

[0065] For example the time interval between two consecutive synchronisation messages of the main control unit 19 can be set at 1 minute or at 20 seconds, depending on the respective requirements of the accuracy of the desired synchronisation and the accuracy of the local clocks of the central control devices 9.

[0066] The time intervals used by the central control devices 9 to transmit their derived master time signal to the bus master devices 17 van be the same for the entire system or may be set individually for each central control unit 9. This setting can be done under the control of the main control unit 19.

[0067] Furthermore, the individual devices of the system can be programmed so as to ignore some of the synchronisation messages, if they do not require the corresponding accuracy. For example a bus master device 17 can be programmed to ignore every second synchronisation message.

[0068] Additionally, the system can be implemented by combining hard and soft synchronisation. For example it might be possible to perform hard synchronisation between the main control unit 19 and the central control devices 17, and to perform soft synchronisation between the central control devices 9 and all or some of the bus master devices 17.

Claims

1. Bus master device for controlling the operation of at least one hazard alarming device (3) comprising:

   a first interface (15) for connecting a first bus (1) coupled with the least one hazard alarming device (3);
   a second interface (5) for connecting a second bus (7) coupled with a central control device (9); and
   an internal time determining device (11) for determining a local time signal to be used to control an alarm operation of the at least one hazard alarming device (3);
   characterized by comprising
   synchronisation means (13) for receiving a master time signal from the central control device (9) via the second bus (7) and for controlling the local time signal based on the master time signal.

2. Bus master device according to claim 1, wherein:

   the synchronisation means (13) is configured to control the local time signal so that upon receiving the master time signal the local time signal is set to the same value as the received master time signal.

3. Bus master device according to claim 1, wherein:

   the synchronisation means (13) is configured to control the local time signal so that upon receiving the master time signal the internal time determining device (11) is accelerated or delayed.

4. Hazard alarming system comprising:

   a central control device (9) for generating a master time signal;
   a plurality of master bus devices (17);
   a plurality of hazard alarming devices (3);
   a plurality of first buses (1) coupling hazard alarming devices (3) out of the plurality of hazard alarming devices (3) with respective once of the plurality of master bus devices (17); and
   a second bus (7) coupling the plurality of master bus devices (17) and the central control device (9)
   characterized in that
   at least two of the master bus devices (17) are configured according to any one of claims 1 to 3.

5. Hazard alarming system according to claim 4, comprising
   a plurality of second buses (7) coupling respective master bus devices (17), wherein the central control device (9) is configured to generate the same master time signal for the plurality of second buses (7).

6. Hazard alarming system according to any of claims 4 or 5, wherein
   the plurality of hazard alarming devices (3) includes a plurality of optical alarming devices (3A) for emitting flash lights, and the optical alarming devices (3A) are coupled with various master bus devices (17) through various first buses (1).

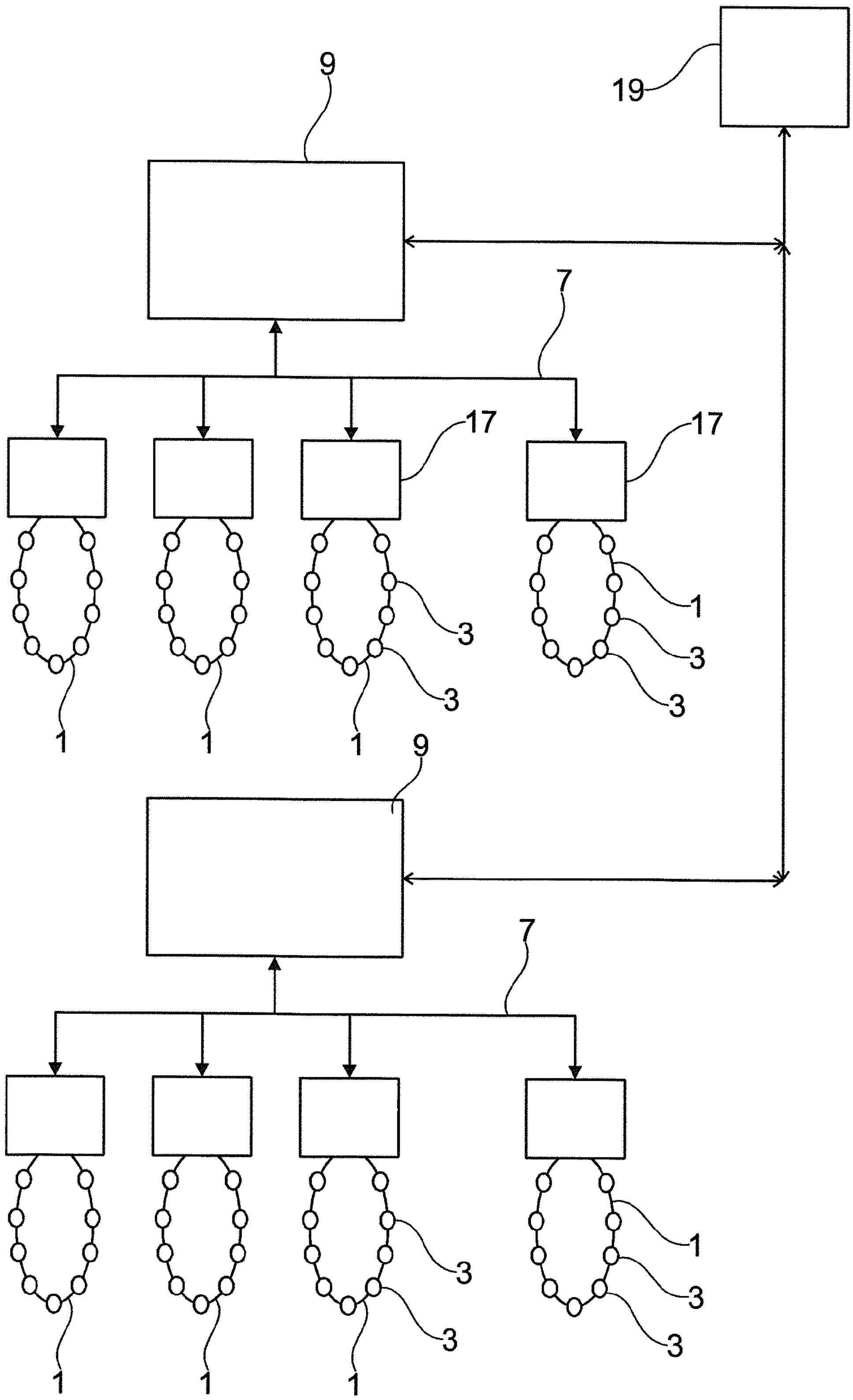

Fig. 1

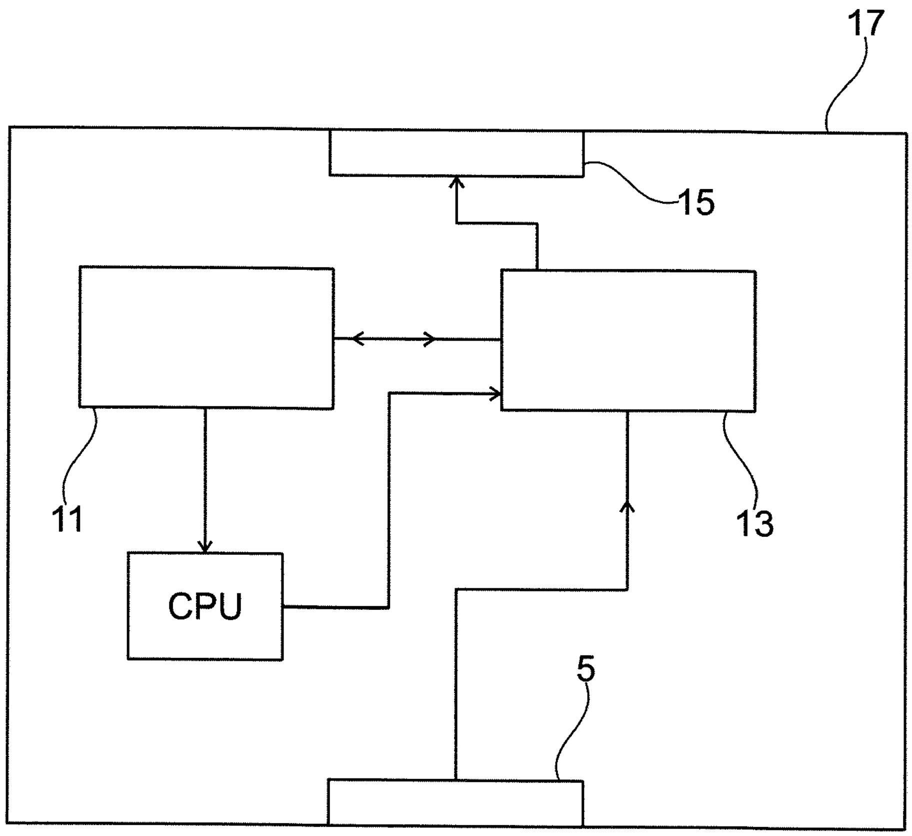

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 14 19 9238

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2013/055599 A1 (SIMPLEXGRINNELL LP [US]) 18 April 2013 (2013-04-18) * figures 1,2 * * last sentence, paragraph 3 - sentence 1, paragraph 4 * * sentence 1, paragraph 5 * * sentence 1, paragraph 22 * * sentence 8, paragraph 26 * * sentences 2,3, paragraph 28 * * sentence 4, paragraph 29 * * sentences 3,4, paragraph 30 * * sentence 1, paragraph 32 * * sentence 1, paragraph 33 * -----	1-6	INV. G08B25/04
A	EP 2 466 564 A2 (HONEYWELL INT INC [US]) 20 June 2012 (2012-06-20) * sentence 2, paragraph 20 * * paragraph [0021] * * sentences 1,5, paragraph 22 * * sentence 1, paragraph 30 * * last sentence, paragraph 31 * * sentence 2, paragraph 33 * * last sentence, paragraph 37 * * sentence 1, paragraph 39 * * figures 1, 2A,2B * -----	1-6	TECHNICAL FIELDS SEARCHED (IPC) G08B
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The present search report has been drawn up for all claims

2

Place of search	Date of completion of the search	Examiner
Munich	27 May 2015	Plathner, B

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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L : document cited for other reasons
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EPO FORM 1503 03.82 (P04C01)

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

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