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(54) **Addressing of signaling units for a bus of a signaling system**

Adressierung von Signalisierungseinheiten für einen Bus eines Signalsystems

Adressage de signalisation d'unités pour un bus d'un système de signalisation

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Description

Background of the invention

[0001] The invention relates to a signaling unit connectable to a bus of a signaling system, in particular of a railway signaling system, comprising: a base part and a removable part detachably connected to the base part, the base part comprising a light directing element, the removable part comprising a light source. The invention also relates to a railway signal comprising a plurality of signaling units, and to a signaling system, in particular to a railway signaling system, as e.g. described in DE 3 223 779 A1.

[0002] Within a railway signaling system, the so-called "interlocking" is the logic architecture which ensures that the routing of trains and the railway signals provided to the trains provide safe operation of the railway network. Trains are controlled and regulated using railway signals. Such a railway signal typically comprises from two to sixteen signaling units, also referred to as light points, and is controlled by the interlocking.

[0003] For the purpose of controlling, each signaling unit is connected to the interlocking via cable connections, typically two leads of a cable providing power to the signaling unit and three further leads being used for communication. **Fig. 2** shows a signaling system **1'** using conventional point-to-point cable connections 2a to **2e** from an interlocking **3** to a plurality of signaling units **4a'** to **4e'**, the signaling units 4a' to 4e' being part of a railway signal 5. In the arrangement of Fig. 2, each cable 2a to 2e comprises two leads, no communication being performed in this case.

[0004] Recently, for reducing cabling expenditures, it has been proposed (see e.g. GB 2 414 327) to use a signaling system **1** having a bus **6** (field bus, e.g. CAN bus, Profibus, etc.) for connecting the interlocking 3 to a plurality of signaling units **4a** to **4e** of a railway signal 5, see **Fig. 3**. The signaling units 4a to 4e each comprise an electronic equipment forming an interface **7a** to **7e** for connecting the signaling units 4a to 4e to the bus 6. The bus 6, e.g. a CAN bus, comprises a single cable connection having five leads, thus providing power from driving the signaling units 4a to 4e, and enabling communication between the interlocking 3 and the signaling units 4a to 4e.

[0005] In the signaling system 1 shown in Fig. 3, it is mandatory to provide each of the signaling units 4a to 4e with a unique bus address - being labeled **A** to E in the following - in order to prevent addressing errors. Such addressing errors have to be prevented in any case, as the signaling system is a safety-critical system, an erroneously switching on of a signaling unit which indicates a free track when the track is actually occupied being a threat for the transportation of people and material.

[0006] For providing a unique bus address to each signaling unit, several possibilities exist, among others using a DIP(dual in-line package)-switch, a software adapted for this purpose, or external contact parts. Yet, due to the safety-critical nature of assigning the correct address to a signaling unit, it is desirable to assign the bus address to the signaling unit once and for all upon initial installation of the signaling unit, not allowing any address change later on.

[0007] However, during the lifetime of a railway signal, resp., signaling unit, the light source (typically a high-power LED, signaling lamp, etc.) is subject to failure, requiring to change the removable part of the signaling unit. As the base part of the signaling unit typically does not comprise electrical components, the bus address information cannot be stored in the base part. However, when storing the bus address information in the removable part, the address information has to be transferred from one the exchanged removable part to the new removable part, the safety-critical transfer of the bus address information being in the hands of service workers which may not be capable of safely performing the transfer.

Object of the Invention

[0008] It is an object of the invention to provide a signaling unit which is adapted for intrinsically safe communication with a bus system.

Summary of the Invention

[0009] This object is achieved by a signaling unit as described in the introduction, wherein the base part comprises an RFID (radio frequency identification) tag adapted to store a bus address of the signalling unit, and wherein the removable part comprises an RFID reader for reading out the bus address of the RFID tag.

[0010] The inventors propose to assign and check the assignment of the bus addresses of each signaling unit during the initial installation of a railway signal. The bus address is then stored on a read-only RFID tag which is attached, e.g. glued, to the base part. In this way, the correct address of the signaling unit is permanently available in the base part. As the base part comprises typically only light directing optics having a high lifetime and is optimized for the specific railway line where the signal is installed (for optimum visibility by the train driver), the base part remains practically always fixed during the lifetime of the railway signal, resp., of the signaling unit, such that the bus address is not modified during the lifetime of the system.

[0011] When exchanging the removable part, only the RFID reader is changed, leaving the RFID tag with the stored bus address unaffected, such that the address cannot be modified by the service workers when exchanging the removable part. It will be understood that the RFID tag is in general a passive tag, the RFID reader providing the power required for initiating the signal transmission. The person skilled in the art will also appreciate that the address information stored on the RFID tag may comprise a checksum for detecting accidental alterations

of the address data or of the transmission, the checksum being calculated by using appropriate algorithms, e.g. CRC (cyclic redundancy check), MD5 (Message-Digest algorithm 5), etc.

[0012] In one embodiment, the signaling unit further comprises an interface for connecting the signalling unit to a bus, in particular to a bus connected to an interlocking. The interface typically comprises the electrical components (microprocessors, etc.) required for performing the connection to the bus and for communicating with the interlocking. Typically, the interface is arranged in the removable part of the signaling unit together with further electrical equipment being used for driving the light source.

[0013] In a further embodiment, the RFID tag is attached to the outside of a housing of the base part, preferably adjacent to a housing of the removable part. In this way, the RFID tag can be fixed to the base part without having to manipulate the base part, i.e. it is not required to open up the base part for arranging the RFID tag inside the housing. When attaching, e.g. gluing, the RFID tag to the housing in an area adjacent to the removable part, the distance between the RFID tag and the RFID reader can be minimized which increases the quality of transmission.

[0014] In one development, a housing of the removable part is adapted to entirely cover the RFID tag for shielding the RFID tag from the environment. For example, a flat surface of the housing of the base part comprising the RFID tag may be covered by a corresponding flat surface of the housing of the removable part when both parts are connected to each other. It will be understood that the removable and/or the base part may also comprise a geometrical feature, for example a collar, for protecting the RFID tag from environmental conditions such as water, heat, etc. The housing of the removable part may also be used as an electromagnetic shielding for avoiding that the RFID tag can be read by RFID readers of neighboring signaling units.

[0015] In a further embodiment, an antenna of the RFID reader is arranged adjacent to the base part, thus reducing the distance between the RF antenna and the RFID tag. Moreover, for avoiding failures, the housing of the removable part may comprise or may itself constitute a RF radiation shielding (being made e.g. of aluminum) surrounding the RFID reader antenna except for the area of the RFID tag, to avoid activation of RFID tags of neighboring signaling units by the RF antenna.

[0016] In a further embodiment, the RFID tag is a passive Low Frequency (LF) Close-coupling RFID tag, being a near field device typically using frequencies in a range from about 30 kHz to 300 kHz. The use of a LF RFID tag with a corresponding LF RFID reader allows confining the range of the RF transmission to the close vicinity of the RFID reader antenna, thus avoiding interferences with signals from RFID tags of neighboring signaling units.

[0017] Typically, the light source is a high-power light-emitting diode, LED, and the base part comprises beam shaping and directing optics for shaping and directing the light emitted from the LED. The base part in general also comprises a mechanical receiving unit for receiving a sign having a contour which is illuminated by the light source. It will be understood that other types of light sources, e.g. signaling lamps, etc. may be used as a light source as well.

[0018] In one embodiment, the light directing element is a lens element, typically focusing the light emitted from the (point) light source. Further light directing elements may include deflecting surfaces or other optical equipment adapted for directing the light of the light source.

[0019] A further aspect of the invention is implemented in a railway signal, comprising a plurality of signaling units according to any one of the preceding claims. As described above, typically two or more signaling units / light points are used in a railway signal. The signaling units of the railway signal may be provided with their unique bus addresses during the initial installation of the railway signal, thus allowing to use fixed addresses during the entire lifetime of the railway signal.

[0020] A further aspect is implemented in a signaling system, in particular for railway signaling, comprising: a bus, and a plurality of signaling units as described above being connected to the bus, each signaling unit having its own, unique bus address, thus providing an intrinsically safe signaling system with reduced cabling expenditure.

[0021] In one embodiment, the signaling system further comprises an interlocking for controlling the signaling units. The interlocking is typically connected to a plurality of railway signals via the same bus / network, the signaling units of all railway signals being equipped with bus addresses being unique in the network.

[0022] Further features and advantages are stated in the following description of exemplary embodiments, with reference to the figures of the drawing, which shows significant details, and are defined by the claims. The individual features can be implemented individually by themselves, or several of them can be implemented in any desired combination.

Brief Description of the Drawings

[0023] Exemplary embodiments are shown in the diagrammatic drawing and are explained in the description below. The following are shown:

Fig. 1 a schematic diagram of an embodiment of a signaling unit with an RFID tag for storing a bus address in a side view and in a front view,

Fig. 2 a schematic diagram of a signaling system with point-to-point connections, and

Fig. 3 a schematic diagram of a signaling system comprising a bus for connecting an interlocking

to a plurality of signaling units, each signaling unit having a bus address which is unique to the signaling system.

Detailed Description of Preferred Embodiments

[0024] **Fig. 1** shows a signaling unit 4a which is adapted to generate a unique bus address "A" for communicating with the (field) bus 6 of the signaling system shown in Fig. 3. The signaling unit 4a comprises a base part **10a** and a removable part **10b**. The base part 10a has a housing **12** forming a front section 11a of the signaling unit 4a, the removable part 10b has a housing **13** which forms a rear section 11 b of the signalling unit 4a. The housing 12 of the base part 10a is fixed to the housing 13 of the removable part 10b by a detachable mechanical connection, e.g. by screws, threaded parts, etc. When connecting the parts 10a, 10b, a light source **14** in the form of a high-power LED arranged at the removable part 10b is inserted into the base part 10a via an opening (not shown) in the housing 12.

[0025] The base part 10a which constitutes the front section 11a of the signaling unit 4a comprises a lens **15** for directing light from the light source 14 to a sign (not shown) illuminated by the light source 14. The housing 12 of the base part 10a is used as a holder for the lens 15 and forms an optical compartment which does not comprise any electrical components. In contrast thereto, the housing 13 of the removable part 10b serves as an electrical compartment, comprising a driver **16** for the light source 14 and an interface **7a** with (active) electrical components for connecting the signalling unit 4a to the bus 6 of Fig. 3.

[0026] The base part 10a has a (self-adhesive) RFID tag **17** on which the bus address A of the signaling unit 4a is stored. The RFID tag 17 is attached to an outer surface **18a** of the housing 12 of the base part 10a, adjacent to an outer surface **18b** of the housing 13 of the removable part 10b, the two surfaces 18a, 18b of the housings 12, 13 being brought into contact when mounting the removable part 10b on the base part 10a. The housing 13 of the removable part 10b comprises an RFID reader **19** having an RF antenna **19a** which is arranged inside the housing 13 adjacent to the base part 10a. The RFID reader 19 reads the bus address of the RFID tag 17 and is connected to the interface 7a which uses the information about the bus address A for selecting those signals on the bus 6 which are addressed to the signaling unit. Such signals may e.g. include commands for switching the light source 14 on or off.

[0027] In the above arrangement, the distance between the RFID tag 17 and the reader antenna 19a is as small as possible, allowing to use a (passive) close-coupling LF RFID tag 17 and a corresponding LF RFID reader antenna 19a. Thus, the RFID standard with the smallest possible transmission range can be chosen, the RF antenna 19a only being adapted to activate the RFID tag 17 of the signaling unit 4a, not affecting RFID tags of the further signaling units 4b to 4e arranged in the vicinity of the signaling unit 4a.

[0028] Also, the removable part 10b resp. its housing 13 acts as a shielding for the signal produced by the RFID tag 17, thus constraining the range where the signal may be detected to the close vicinity of the RFID antenna 19a, avoiding that the signal can be read by RFID readers of the further signaling units 4b to 4e. For protecting the RFID tag 17 from environmental conditions, the housing 13 of the removable part 10b comprises a collar **20** sealing the interspace between the surfaces 18a, 18b of the housings 12, 13 of the base part 10a and of the removable part 10b from the environment.

[0029] The bus address A is attributed to the signaling unit 4a once and for all during the initial installation of the signaling unit 4a, the bus address being stored in the read-only RFID tag 17 which is fixed to the housing 12 of the base part 10a. During maintenance of the railway signal 5, typically the base part 10a of the signaling unit 4a is not removed, as the optical elements arranged therein do not require to be changed during the life-time of the railway signal 5. Thus, the RFID address "A" stored in the RFID tag 17 remains unchanged even if the removable part 10b of the signaling unit 4a is changed due to a failure of electrical components or of the light source 14 comprised therein.

[0030] In summary, by permanently storing the bus address in the RFID tag of the base part of the signaling unit, an intrinsically safe addressing of the signaling unit via a field bus can be provided. It will be understood that further measures may be taken to check the correct transmission of the signal from the RFID tag to the RFID reader, e.g. by adding a checksum to the data stored in the RFID tag.

[0031] The person skilled in the art will appreciate that the signaling units described herein may be used in railway signaling equipment, by may also be advantageously used in other types of signaling equipment, for example in air or marine applications. Moreover, the above approach may be applied to a variety of field bus standards, for instance CAN bus, Profibus, etc.

[0032] The above description of preferred embodiments has been given by way of example. From the disclosure given, those skilled in the art will not only understand the present invention and its attendant advantages, but will also find apparent various changes and modifications to the structures and methods disclosed. The applicant seeks, therefore, to cover all such changes and modifications as defined by the appended claims, and equivalents thereof.

Claims

1. Signaling unit (4a to 4e) connectable to a bus (6) of a signalling system, in particular of a railway signalling system (1), comprising:

a base part (10a) and a removable part (10b) detachably connected to the base part (10a), the base part (10a) comprising a light directing element (14), the removable part (10b) comprising a light source (14),
characterized in that
the base part (10a) comprises an RFID tag (17) adapted to store a bus address (A to E) of the signalling unit (4a to 4e), and the removable part (10b) comprises an RFID reader (19) for reading out the bus address (A to E) of the RFID tag (17).

2. Signaling unit according to claim 1, further comprising an interface (7a to 7e) for connecting the signalling unit (4a to 4e) to a bus (6), in particular to a bus of an interlocking (3).

3. Signaling unit according to claim 1 or 2, wherein the RFID tag (17) is attached to the outside of a housing (12) of the base part (10a), preferably adjacent to a housing (13) of the removable part (10b).

4. Signaling unit according to claim 3, wherein a housing (13) of the removable part (10b) is adapted to entirely cover the RFID tag (17) for shielding the RFID tag (17) from the environment.

5. Signaling unit according to any one of the preceding claims, wherein an RF antenna (19a) of the RFID reader (19) is arranged adjacent to the housing (12) of the base part (10a).

6. Signaling unit according to any one of the preceding claims, wherein the RFID tag (17) is a Low Frequency Close-Coupling RFID tag.

7. Signaling unit according to any one of the preceding claims, wherein the light source (14) is a high-power light-emitting diode.

8. Signaling unit according to any one of the preceding claims, wherein the light directing element is a lens element (15).

9. Railway signal (5), comprising a plurality of signaling units (4a to 4e) according to any one of the preceding claims.

10. Signaling system (1), in particular for railway signaling, comprising:

a bus (6), and
a plurality of signaling units (4a to 4e) according to any one of the preceding claims being connected to the bus (6), wherein each signaling unit (4a to 4e) has its own, unique bus address (A to E).

11. Signaling system (1) according to claim 10, further comprising: an interlocking (3) for controlling the signaling units (4a to 4e).

Patentansprüche

1. Signaleinheit (4a - 4e), die mit einem Bus (6) eines Signalsystems verbindbar ist, insbesondere eines Eisenbahnsignalsystems (1), umfassend:

ein Basisteil (10a) und ein entfernbares Teil (10b), das lösbar mit dem Basisteil (10a) verbunden ist, wobei das Basisteil (10a) ein Lichtlenkelement (14) und das entfernbare Teil (10b) eine Lichtquelle (14) aufweist, **dadurch gekennzeichnet, dass**
das Basisteil (10a) ein RFID-Tag (17) aufweist, das so ausgebildet ist, dass es eine Busadresse (A - E) der Signaleinheit (4a - 4e) speichert und der entfernbare Teil (10b) einen RFID-Leser (19) aufweist zum Auslesen der Busadresse (A - E) des RFID-Tags (17).

2. Signaleinheit nach Anspruch 1, weiterhin umfassend eine Schnittstelle (7a - 7e) zum Verbinden der Signaleinheit (4a - 4e) mit einem Bus (6), insbesondere einem Bus eines Stellwerks (3).

3. Signaleinheit nach Anspruch 1 oder 2, wobei das RFID-Tag (17) an der Außenseite eines Gehäuses (12) des Basisteils (10a) befestigt ist, vorzugsweise neben einem Gehäuse (13) des entfernbaren Teils (10b).

4. Signaleinheit nach Anspruch 3, wobei ein Gehäuse (13) des entfernbaren Teils (10b) so ausgebildet ist, dass es das RFID-Tag (17) komplett abdeckt, um das RFID-Tag (17) von der Umgebung abzuschirmen.

5. Signaleinheit nach einem der vorhergehenden Ansprüche, wobei eine RF-Antenne (19a) des RFID-Lesers (19) neben dem Gehäuse (12) des Basisteils (10a) angeordnet ist.

6. Signaleinheit nach einem der vorhergehenden Ansprüche, wobei das RFID-Tag (17) ein niederfrequentes Close-Coupling RFID-Tag ist.

7. Signaleinheit nach einem der vorhergehenden Ansprüche, wobei die Lichtquelle (14) eine Hochleistungs-Leuchtdiode ist.

8. Signaleinheit nach einem der vorhergehenden Ansprüche, wobei das Lichtlenkelement ein Linsenelement (15) ist.

9. Eisenbahnsignal (5), umfassend eine Mehrzahl von Signaleinheiten (4a - 4e) nach einem der vorhergehenden Ansprüche.

10. Signalsystem (1), insbesondere für das Eisenbahnsignalwesen, umfassend:

einen Bus (6), und
eine Mehrzahl von Signaleinheiten (4a - 4e) nach einem der vorhergehenden Ansprüche, die mit dem Bus (6) verbunden sind, wobei jede Signaleinheit (4a - 4e) ihre eigene eindeutige Busadresse (A - E) hat.

11. Signalsystem (1) nach Anspruch 10, weiterhin umfassend: ein Stellwerk (3) zum Steuern der Signaleinheiten (4a - 4e).

Revendications

1. Unité de signalisation (4a à 4e) connectable à un bus (6) d'un système de signalisation, en particulier d'un système de signalisation de voie ferrée (1), comprenant :

une partie de base (10a) et une partie amovible (10b) raccordée de manière détachable à la partie de base (10a), la partie de base (10a) comprenant un élément dirigeant la lumière (14), la partie amovible (10b) comprenant une source de lumière (14), **caractérisée en ce que**
la partie de base (10a) comprend une étiquette RFID (17) adaptée pour stocker une adresse de bus (A à E) de l'unité de signalisation (4a à 4e), et la partie amovible (10b) comprend un lecteur RFID (19) pour lire l'adresse de bus (A à E) de l'étiquette RFID (17).

2. Unité de signalisation selon la revendication 1, comprenant en outre une interface (7a à 7e) pour raccorder l'unité de signalisation (4a à 4e) à un bus (6), en particulier à un bus d'un poste d'aiguillage (3).

3. Unité de signalisation selon la revendication 1 ou 2, dans laquelle l'étiquette RFID (17) est attachée à l'extérieur d'un boîtier (12) de la partie de base (10a), de préférence adjacente à un boîtier (13) de la partie amovible (10b).

4. Unité de signalisation selon la revendication 3, dans laquelle un boîtier (13) de la partie amovible (10b) est adapté pour couvrir entièrement l'étiquette RFID (17) pour protéger l'étiquette RFID (17) de l'environnement.

5. Unité de signalisation selon l'une quelconque des revendications précédentes, dans laquelle une antenne RF (19a) du lecteur RFID (19) est agencée en position adjacente au boîtier (12) de la partie de base (10a).

6. Unité de signalisation selon l'une quelconque des revendications précédentes, dans laquelle l'étiquette RFID (17) est une étiquette RFID basse fréquence à couplage rapproché.

7. Unité de signalisation selon l'une quelconque des revendications précédentes, dans laquelle la source de lumière (14) est une diode électroluminescente haute puissance.

8. Unité de signalisation selon l'une quelconque des revendications précédentes, dans laquelle l'élément dirigeant la lumière est un élément de lentille (15).

9. Signal de voie ferrée (5), comprenant une pluralité d'unités de signalisation (4a à 4e) selon l'une quelconque des revendications précédentes.

10. Système de signalisation (1), en particulier pour la signalisation de voie ferrée, comprenant :

un bus (6), et
une pluralité d'unités de signalisation (4a à 4e) selon l'une quelconque des revendications précédentes étant raccordées au bus (6), où chaque unité de signalisation (4a à 4e) a sa propre adresse de bus unique (A à E).

11. Système de signalisation (1) selon la revendication 10, comprenant en outre : un poste d'aiguillage (3) pour commander les unités de signalisation (4a à 4e).

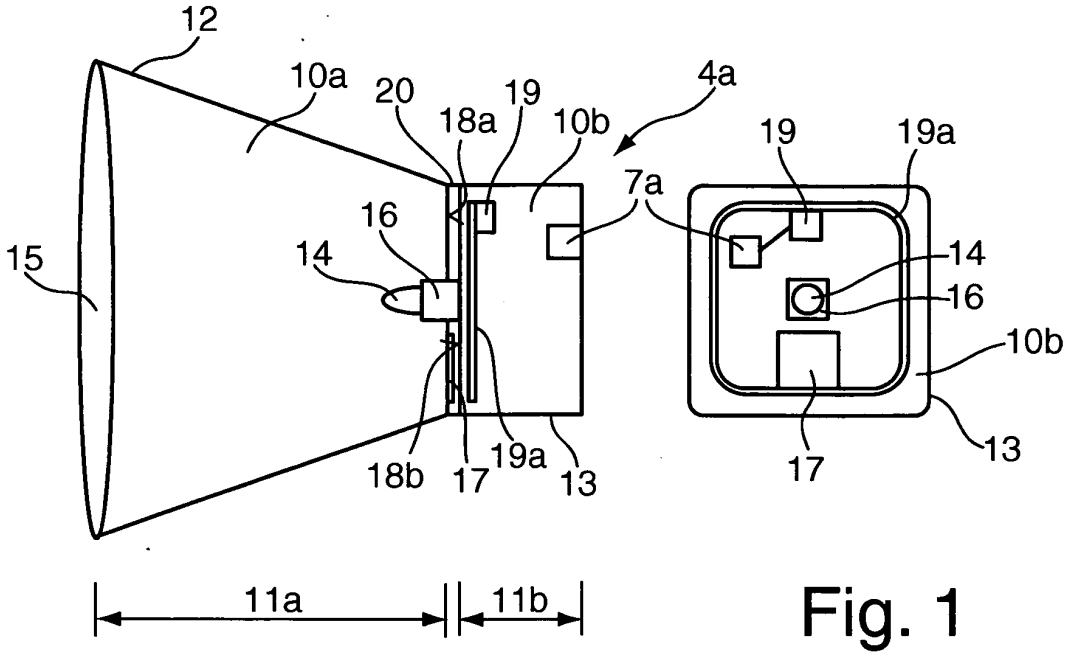

Fig. 1

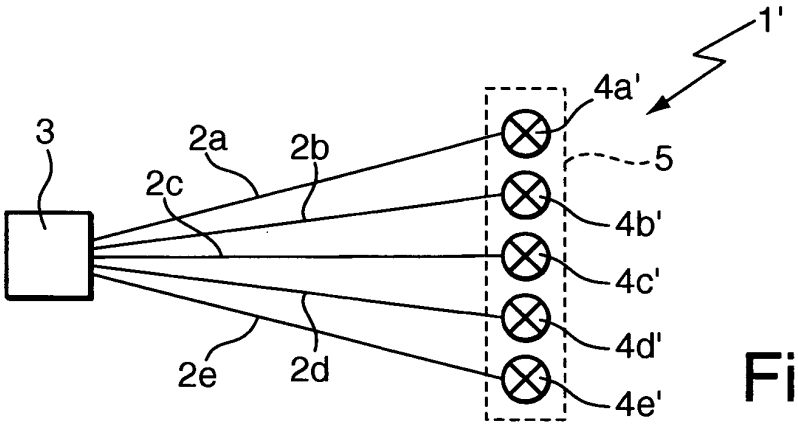

Fig. 2

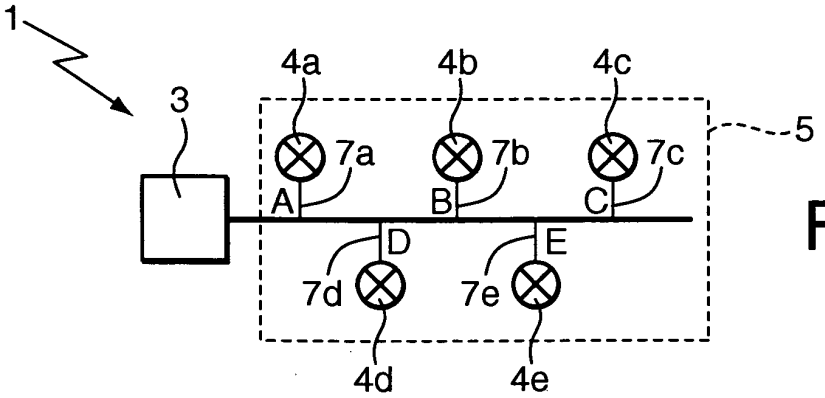

Fig. 3

REFERENCES CITED IN THE DESCRIPTION

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