(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
12 February 2015 (12.02.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/019372 A1

(51) International Patent Classification:
G08B 17/00 (2006.01) *G06Q 10/08* (2012.01)
G08B 29/16 (2006.01) *G08B 25/04* (2006.01)

(21) International Application Number:
PCT/IT2013/000224

(22) International Filing Date:
9 August 2013 (09.08.2013)

(25) Filing Language: Italian

(26) Publication Language: English

(71) Applicant: **MARTEC S.P.A.** [IT/IT]; Vicolo Lambro, 1, I-20900 Monza (MB) (IT).

(72) Inventors: **FOGAZZARO, Gian, Giacomo**; Strada Padana Superiore (SP11), 1/61, I-20063 Cernusco Sul Naviglio (MI) (IT). **BRACCO, Lorenzo**; Loc. Stornello, 6, I-12050 Sinio (CN) (IT). **GAVAZOV, Valentin, Vladimirov**; Via Canonico Franscesco C, 5, I-12046 Montà (CN) (IT).

(74) Agent: **CICERI, Fabio**; c/o Perani & Partners, Piazza San Babila, 5, I-20122 Milan (MI) (IT).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(54) Title: SYSTEM FOR TRACKING THE POSITION OF PERSONS OR ITEMS IN STRUCTURES PROVIDED WITH ROOMS INTENDED TO RECEIVE PERSONS OR ITEMS, SUCH AS SHIPS, BUILDINGS OR OFFSHORE PLATFORMS

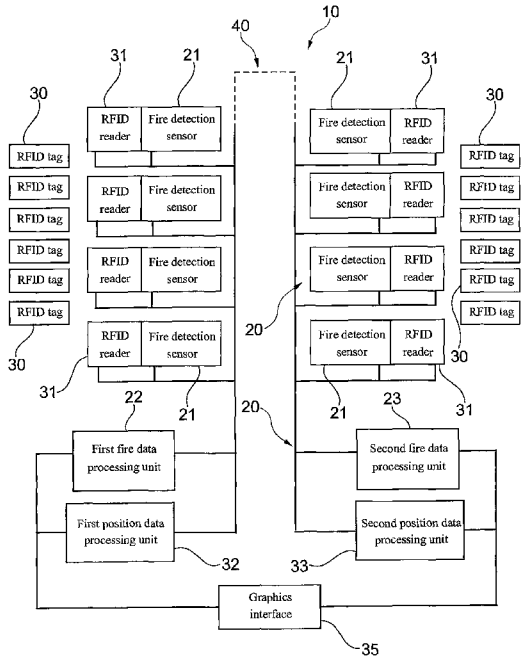

FIG. 1

(57) Abstract: The present invention relates to a system (10) for tracking the position of persons or items in facilities (1) having a plurality of rooms (2). The system (10) comprises a fire detection system (20) having fire detection sensors (21) and at least one fire data processing unit (22), a plurality of RFID tags (30), a plurality of RFED readers (31) located at respective fire detection sensors (21), at least one position data processing unit (32) and at least one bipolar line (40) that extends in the plurality of rooms (2) to establish signal communication between the fire detection sensors (21) and the fire data processing unit (22), and between the RFID readers (31) and the position data processing unit (32), and to supply power to the fire detection sensors (21) and the RFID readers (31).

WO 2015/019372 A1

Title: "System for tracking the position of persons or items in structures provided with rooms intended to receive persons or items, such as ships, buildings or offshore platforms"

The present invention relates to a system for tracking the position of persons or items in facilities having a plurality of rooms for receiving persons or items, such as ships, building or offshore platforms (e.g. oil rigs).

The problem of tracking the position of persons in buildings and ships is highly felt, particularly but without limitation in emergencies. In these circumstances, the use of persons tracking systems provides quick and accurate position of individuals in a building or ship, to allow quick and effective response of task forces, such as fire and health departments. These tracking systems may be also used for different purposes such as elderly and children care, or for commercial purposes.

Systems for tracking persons, articularly for tracking passengers on ships, are disclosed in US 2011/109434 and US 2011/84830.

US 2011/109434 discloses a system for tracking passengers on cruise ships. This system uses an RFID apparatus in signal communication with a tracking system having appropriate software and a monitor for displaying the map of the ship, to facilitate position of the passenger to be tracked. Signal communication between the RFID apparatus and the tracking system is provided by wired or wireless means. The operation of the RFID system is the traditional operation in which the tracked object is integral with a mobile transponder, known as RFID tag, with fixed transponders, known as RFID readers arranged in monitored areas of the ship. The RFID tags and RFID readers establish a wireless communication through which the system can determine the position of the tag, and hence the object being tracked, by their own logics. In this particular case, the tag generates a signal to indicate its presence and tag position occurs by comparing the powers received by RFID readers.

US 2011/84830 discloses an emergency control system based on tracking the position of passengers on a ship, using a sensor network. Particularly, this tracking system comprises an emergency recognition apparatus, a position apparatus and a central control unit. The emergency recognition apparatus detects accidents on the

ship, such as fires, and has a plurality of sensors arranged in various places in the ship. The position apparatus detects passenger position using RFID systems, where RFID readers are arranged in every place of the ship in which the presence of passengers is expected. The operation of the RFID position system is as described above. The emergency control system uses PLC (Power Line Communication) and LAN (WAN) line, separately or simultaneously, to implement a telecommunication network.

While the above described systems allow tracking the position of persons in a ship, the technical solutions suggested thereby do not provide satisfactory passenger position reliability, in terms of both robustness of the system against damage, and installation costs.

The characteristics required of a satisfactory position system, e.g. on a ship, may be summarized as follows:

- Accurate position: the position of the persons being monitored should be correctly detected, with no false position, and no position event should be lost.
- Capillary distribution, for accurate capture of any displacement of the persons being monitored.
- System reliability against adverse events: the system should ensure generally continuous operation when one of its parts is damaged.
- Costs: the system should have a low cost.

Concerning the first item, i.e. accuracy, it should be first considered that ships contain a considerable amount of metal materials, that can reflect and guide the electromagnetic waves generated by RFID readers and tags. Compartments, as well as the floors and ceilings of decks are generally made of steel. Such reflection and guide effects might generate uneven electromagnetic fields, involving the risk of over-detection or under-detection by RFID readers, eventually resulting in wrong position of the person being tracked. These effects are proportional to the powers used by RFID systems. Secondly, it should be considered that the human body tends to shield the electromagnetic waves that are typically used in RFID tracking systems. This requires an increase of the powers used by the RFID system to ensure that position is maintained in any possible configuration. It will be noted that the above

issues have diverging power requirements, whereby compromise power levels must be used, which result in poorly reliable systems. A more detailed description of the operation is provided in US 2011/84830, involving the installation of RFID readers in every room of the ship in which the presence of passengers is expected. While this approach is not the optimal solution, it would still provide good accuracy results, due to the density of RFID readers. Nevertheless, this solution is still inadequate. The possibility that a passenger might be in an room where no RFID reader is placed, in an emergency, should not be neglected. Alternatively, RFID readers may be installed in every room of the ship. This would generally increase the installation costs of the tracking system, and particularly wiring costs. Furthermore, the suggested use of a PLC line for data transmission involves a number of drawbacks: it limits data transmission capacity, introduces noise in data transmission and does not provide a system capable of ensuring both reliability and capillarity. Main power lines typically have a capillary distribution but do not ensure robustness against damage, whereas emergency power lines are reliable but have no capillary distribution.

The above description of the prior art clearly shows that there is a need for a system for accurate, capillary and reliable tracking the position of persons and items in buildings, ships and the like, that has low installation and wiring costs.

In view of the above discussed prior art, the object of the present invention is to fulfill the above need, while obviating the prior art drawbacks.

According to the present invention, this object is fulfilled by a system for tracking the position of persons or items as defined in claim 1.

The characteristics and advantages of the present invention will appear from the following detailed description of one practical embodiment, which is illustrated without limitation in the annexed drawings, in which:

- Figure 1 shows a block diagram of a first embodiment of the tracking system of the present invention,

- Figure 2 is a diagrammatic view of an RFID reader used in the system of Figure 1,

- Figure 3 shows an exemplary implementation of the tracking system of the present invention on a ship,

- Figure 4 shows an exemplary implementation of the tracking system of the present invention in a theater,

- Figure 5 shows an exemplary implementation of the tracking system with the antenna of the RFID reader encircling a door,

- Figures 6a, 6b and 6c show different embodiments of the bipolar line of the tracking system of Figure 1,

- Figure 7 shows a flowchart of a tracking method that is carried out using the system of the present invention.

Referring to the annexed figures, numeral 10 generally designates a system for tracking the position of persons or items according to an embodiment of the present invention.

The system 10 is able to track the position of persons or items in a facility 1 comprising a plurality of rooms 2 intended to receive a plurality of persons or items.

For example, the system 10 may find application in system for tracking the position of persons or items in buildings, ships and oil rigs. Particularly, persons position tracking may have safety and emergency handling purposes, in emergency situations, or commercial purposes, especially at points-of-sale, or elderly and children care purposes, should elderly persons or children get lost in the rooms 2.

For conciseness, reference will be made hereinafter, without limitation, to a method of tracking persons in a passenger ship.

The system 10 comprises a fire detection system 20. This fire detection system 20 comprises a plurality of fire detection sensors 21 and at least one fire data processing unit, here a first fire data processing unit 22 and a second fire data processing unit 23. For conciseness, reference will be made hereinafter, without limitation, to the first fire data processing unit 22. The advantages provided by the use of the second fire data processing unit 23 will be detailed hereinafter.

Fire detection sensors 21 are placed in the rooms 2, preferably in a series connection scheme. The fire detection sensors 21 are advantageously placed on the ceiling of the rooms, in such position as to be able to effective sense any smoke, flame or heat change or any initial fire.

Each fire detection sensor 21 is configured to generate an alarm signal Sal.

The first fire data processing unit 22 is in signal communication with the fire detection sensors 21 and is able to receive the alarm signals Sal generated by the fire detection sensors.

It should be noted that the fire detection system 20 has the following characteristics: high reliability against adverse events; full topological coverage, particularly on ships. The above mentioned characteristics are of great interest for the tracking system 10, as explained below.

In order to track the position of persons moving through the rooms 2, the system 10 comprises a plurality of RFID tags 30, a plurality of RFID readers 31 and at least one position data processing unit 32, here a first position data processing unit 32 and a second position data processing unit 33. For conciseness, reference will be made hereinafter, without limitation, to the first position data processing unit 32. The advantages provided by the use of the second position data processing unit 33 will be detailed hereinafter.

Each RFID tag 30 is able to be associated to one person intended to move through the rooms 2. It shall be noted that each RFID tag 30 has a unique identification code ID. Therefore, associating an RFID tag 30 with a person allows such identification code ID to provide unique identification of that person, as long as the latter has the associated RFID tag 30 thereon.

In one embodiment, the RFID tag 30 may be applied to a bracelet, a brooch or an identification badge.

In one embodiment, the RFID tag 30 is active, i.e. having its own power source. Nevertheless, the present invention is intended to also cover embodiments in which the RFID tag 30 is passive, i.e. where the electromagnetic field generated by the RFID reader provides the RFID tag with the power required for its operation.

The RFID readers 31 are arranged in the rooms 2 at their respective fire detection sensors. In a preferred embodiment, the RFID readers 31 are stably mounted to elements defining the rooms 2, e.g. ceilings or false ceilings, or to elements placed within the rooms 2.

Each RFID reader 31 is configured to detect an RFID tag 30, advantageously by means of mechanisms that will be better explained below and, upon detection of

the RFID tag 30, to generate a position signal Sp representative of the detected RFID tag 30 and the position of the RFID tag 31.

The position data processing unit 32 is in signal communication with the RFID readers 31 and is able to receive the position signals Sp generated by the RFID readers 31.

The system 10 further comprises at least one bipolar line 40, extending in the rooms 2.

In a first embodiment, the system 10 comprises a single bipolar line 41.

In a second embodiment, the system 10 comprises two bipolar lines 42, 43.

For simplicity and unless otherwise stated, reference will be made hereinafter to a "bipolar line" to designate both embodiments.

The bipolar line is configured to establish signal communication between the fire detection sensors 21 and the RFID readers 31 and the fire data processing units 22 and 23 and the position data processing units 32 and 33 respectively, and to supply power to the fire detection sensors 21 and the RFID readers 31. The use of this bipolar line in combination with the arrangement of the RFID readers 31 close to their respective fire detection sensors 21 provides the fire detection system 20 with a capillarity feature and reduces the costs for installation and wiring of the tracking system. Particularly in new constructions, either buildings or ships, the tracking system 10 will benefit from the infrastructure designed for the fire detection system 20. If a tracking system is installed in buildings or ships that already have a fire detection system, the tracking system may use the single bipolar line of the fire detection system, or a second bipolar line may be provided, dedicated to the tracking system and lying adjacent to the existing line. These aspects will be better explained hereinafter. It should be noted that the common use of the above mentioned infrastructure allows the position system 10 to benefit from the reliability and robustness against damage of the infrastructure of fire detection systems in general and of fire detection systems in ships in particular, and affords capillary coverage of the entire ship, while reducing installation and wiring costs.

Typically, the fire detection system 20 comprises a cable duct 25 extending in the rooms 2, and leading to each fire detection sensor 21. This cable duct 25 may be

advantageously used for accommodation of the bipolar line, thereby further reducing the costs for installation and wiring of the tracking system.

As disclosed above, in a first embodiment, the system 10 comprises a single bipolar line 41, which is used to transmit the alarm signals Sal generated by the fire detection sensors 21 and the position sensors Sp generated by the RFID readers 31.

In this first embodiment, the alarm signals Sal and the position signals Sp are transmitted over the single bipolar line 41. The single bipolar line 41 is further configured to supply power to the fire detection sensor 21 and the RFID readers 31.

For this purpose, a frequency separation is obtained between the alarm signals Sal and the position signals Sp. For example, if the position signals Sp are modulated by a carrier frequency, the alarm signals Sal may remain in the baseband, and low-pass filters and band-pass filters may be provided at the first fire data processing unit 22 and the first position data processing unit 32 respectively, otherwise two distinct frequency bands may be used.

Alternatively, the alarm signals Sal and the position signals Sp may be transmitted at a single frequency, at different times.

According to a second embodiment, the system 10 comprises a first bipolar line 42 for the fire detection system 10 and a second bipolar line 43 for the RFID readers 31, which extends adjacent to the first bipolar line 42.

The first bipolar line 42 is configured to establish signal communication between the fire detection sensors 21 and the first fire data processing unit 22 and to supply power to the fire detection sensors 21.

The second bipolar line 43 is configured to establish signal communication between the RFID readers 31 and the first position data processing unit 32 and to supply power to the RFID readers 31.

The first bipolar line 42 and the second bipolar line 43 may be embedded in a single four-pole cable C1, or in two distinct but adjacent two-pole cables C2, C3. Referring to the first embodiment having a single bipolar line, a single two-pole cable C4 will be obviously provided.

The four-pole cable C1 or the two two-cable cables C2, C2, or the single two-pole cable C4 may be advantageously placed in the cable duct 25 that extends in the

rooms 2 to reach each fire detection sensor 21. Obviously, when two cables C2, C3 are provided, the use of two adjacent cable ducts shall be intended to be covered by the scope of the present invention.

Advantageously, each RFID reader 31 is placed immediately adjacent to a respective fire detection sensor 21. Particularly, in each pair composed of an RFID reader 31 and its respective fire detection sensor 21, the fire detection sensor 21 may be disposed within a first enclosure 24 and the RFID reader 31 may be disposed in a second enclosure 34, otherwise the fire detection sensor 21 and the RFID reader 31 may be disposed in a single enclosure.

When two enclosures are provided, the second enclosure 34 is separated from the first enclosure 24 and placed adjacent to the first enclosure 24. This will maintain the advantages of a cost-effective installation, and fulfill further requirements, such as the requirement of accommodating the RFID readers 31 in dedicated enclosures 34, when there is not enough room in the enclosures 24 of the fire detection sensors 21. It should be noted that, due to the common use of the above mentioned infrastructure of the fire detection system 20, the system 10 already provides an improvement with respect to the prior art, in terms of accuracy, reliability and robustness against damage, capillarity and costs.

In one embodiment, which provides optimized use of the capillarity provided by the above described system 10 for the purpose of accurate position, each RFID reader 31 is configured to generate a wake-up signal Swake. Particularly, the wake-up signal Swake is an electromagnetic signal generated over the air.

Advantageously, the wake-up signal Swake is a low-frequency signal, preferably in the range from 10 KHz to 1 MHz. The use of a low-frequency wake-up signal Swake prevents the creation of waveguides, as the metal structures have such a size as to be unable to guide this low-frequency signal. Since the human body is substantially transparent to low frequencies, the low frequency may be advantageously combined with a low power of the wake-up signal Swake, thereby preventing any reflection in the rooms 2 and thus avoid wrong position problems.

The signal Swake can activate an RFID tag 30 in a preset area A around the RFID reader 31. This preset area A corresponds to the lobe of the wake-up signal

Swake generated by the RFID reader 31.

The lobe of the wake-up signal Swake has a width Lmax, typically smaller than or equal to the distance D between two contiguous RFID readers 31 and a maximum height Hmax. By this arrangement, the wake-up signal Swake may be radiated to the various rooms 2, such that the areas that are not covered by the lobes of the RFID readers 31, and the risk of wrong positions may be minimized.

Preferably, the lobes of the wake-up signals Swake of two contiguous RFID readers 31 have such a shape as to avoid mutual overlapping. This will prevent the risk that two RFID readers 31 may activate the same RFID tag 30, which will cause uncertainty about the position of the person having the activated RFID tag 30 thereon. This will be described in greater detail hereinbelow.

It shall be noted that the RFID readers 31 can be configured in terms of power of the wake-up signal Swake, from a minimum value Pmin to a maximum value Pmax, such that the lobes may be changed both in their maximum width Lmax and in their maximum height Hmax. For example, the values Pmax and Lmax may be set to a value ranging from 0 meters to 10 meters.

The wake-up signal Swake generated by an RFID reader 31 comprises PosR data representative of the position of the RFID reader 31.

Upon receiving a wake-up signal Swake by an RFID reader 31, each RFID tag 30 is configured to generate an electromagnetic signal Stag over the air, which comprises data representative of its own identification code ID and the PosR data representative of the position of the RFID reader 31 which generated the wake-up signal Swake received by the RFID tag 30.

Advantageously, the tag signal Stag is a high-frequency electromagnetic signal generated over the air, preferably ranging from 500 MHz to 10 GHz. The use of a high-frequency tag signal Stag is particularly advantageous, because this tag signal Stag may be detected by any RFID reader 31, not necessarily the RFID reader 31 that activated the RFID tag 30. Furthermore, unlike low-frequency signals, a high-frequency signal may be easily generated also by small-size devices such as a tag. This does not affect the reliability of position tracking of the RFID tag 30, and hence the person associated therewith, as the position data PosR is provided to the activated

RFID tag 30 by the RFID reader 31 that activates the RFID tag 30. With this scheme, reflections and waveguides, which are often important in metal rooms, such as ships or offshore platforms, are no longer a limiting noise, but an advantage.

For example, the power of the wake-up signal Swake, either at low frequency or at low frequency, may be set to a value ranging from 10 mW to 500 mW.

The arrangements as described above, which are provided to prevent two RFID readers 31 from activating the same RFID tag 30, show the highly advantageous feature of the low-frequency and high-frequency signals, respectively for the wake-up signals Swake and the tag signals Stag.

Each RFID reader 31 is configured to receive a tag signal Stag generated by an activated RFID tag 30, and to send a position signal Sp to the position data processing unit 32, with the position signal Sp comprising the identification code ID of the RFID tag 30 and the PosR representative of the position of the RFID reader 31 that generated the wake-up signal Swake.

Generally, each RFID reader 31 is placed in an enclosure and comprises a radiating antenna 36 for radiating the wake-up signal Swake that can activate an RFID tag 30.

In view of fulfilling special requirements, the antenna 36 may be located outside the enclosure 34 to radiate the wake-up signal Swake at a distance from the RFID reader 31. This configuration is advantageous when the RFID reader 31 is mounted to the ceiling and the distance between the ceiling and the floor is greater than the height of the lobe of the wake-up signal Swake, which would prevent detection of any RFID tag 30. This occurs, for instance, in theaters or generally in rooms having very high ceilings, such as shopping malls, sheds, etc.

Once the position data processing unit 32 has received the position signals Sp generated by said RFID readers 31, these signals Sp may be appropriately processed to be rendered in graphical form, such that they may be displayed on a graphics interface 35. This graphics interface 35 is embodied by one or more monitors, which may display a map of the rooms of the ship, the building or the offshore platform, as well as the position of the RFID readers 13, for position tracking of the person or item in these rooms 2.

As mentioned above, the fire detection system 20 may comprise a second fire data processing unit 23, which is also configured to be in signal communication with the fire detection sensors 21 and is able to receive the alarm signals Sal generated by the fire detection sensors 21.

The first and second fire data processing units 22, 23 of the fire detection system 20 are located at the ends of the bipolar line 40. Thus, if a failure occurs in a fire detection sensor 21, e.g. the n^{th} sensor, this will not affect detection by the sensors upstream or downstream from the n^{th} sensor, since fire detection is carried out by the first fire data detection unit 22 up to the n^{th} sensor, and by the second fire data processing unit 23 from the n^{th} sensor + 1 on.

This arrangement also facilitates the identification of the malfunctioning n^{th} sensor.

The fire detection system 20 ensures high reliability, which may be extended to the position tracking components that share the infrastructure of such fire detection system 20, as mentioned above, if two position data processing unit 32 and 33 are used, with a configuration identical to that described concerning the fire detection system 20.

It shall be noted that the fire detection system 20 comprises an autonomous uninterruptible power supply which may both supply power to the fire detection sensors 21 and to the first and second fire data processing units 22, 23, and supply power to the plurality of RFID readers 31 and to the position data tracking unit 32.

It will be appreciated that the system of the present invention fulfills the intended purposes.

Those skilled in the art will obviously appreciate that a number of changes and variants may be made to the arrangements as described hereinbefore to meet incidental and specific needs.

All the changes will fall within the scope of the invention, as defined in the following claims.

CLAIMS

1. A system (10) for tracking the position of persons or items in facilities (1) having a plurality of rooms (2) for receiving a plurality of persons or items, such as ships, building or offshore platforms, said system (10) comprising:

- a fire detection system (20) comprising:

- a plurality of fire detection sensors (21) arranged in said rooms (2), each fire detection sensor (21) being configured to generate an alarm signal (Sal),

- at least one fire data processing unit (22, 23) in signal communication with said plurality of fire detection sensors (21) and able to receive the alarm signals (Sal) generated by the fire detection sensors (21),

characterized in that it comprises:

- a plurality of RFID tags (30), each RFID tag (30) being able to be associated with a respective person or item, intended to move in said rooms (2),

- a plurality of RFID readers (31) arranged in said rooms (2), each RFID reader (31) being arranged at a respective fire detection sensor (21) and being configured to detect an RFID tag (30) and to generate a position signal (Sp) representative of the detected RFID tag (30) and the position of said RFID tag (31),

- at least one position data processing unit (32) in signal communication with said plurality of RFID readers (31) and able to receive the position signals (Sp) generated by said RFID readers (31),

- at least one bipolar line (40) extending in said plurality of rooms (2), said at least one bipolar line (40) being configured to:

- establish signal communication between said plurality of fire detection sensors (21) and said at least one fire data processing unit (22),

- establish signal communication between said plurality of RFID readers (31) and said at least one position data processing unit (32),

- supply power to said plurality of fire detection sensors (21) and said plurality of RFID readers (31).

2. A system (10) as claimed in claim 1, wherein said fire detection system (20)

comprises a cable duct (25) extending in said plurality of rooms (2), said at least one bipolar line (40) being laid in said cable duct (25).

3. A system (10) as claimed in claim 1 or 2, wherein:
- said at least one bipolar line is a single bipolar line (41),
- said alarm signals (Sal) and said position signals (Sp) are transmitted over said single bipolar line (41),
- said single bipolar line (41) being configured to supply power to said plurality of fire detection sensors (21) and said plurality of RFID readers (31).

4. A system (10) as claimed in claim 3, wherein said alarm signals (Sal) and said position signals (Sp) are transmitted over said single bipolar line (41), are encoded by analog modulation or digital modulation and are separated by frequency using two distinct frequency bands.

5. A system (10) as claimed in claim 3, wherein said alarm signals (Sal) and said position signals (Sp) are transmitted over said single bipolar line (41) are encoded by analog modulation or digital modulation, occupy the same frequency band, and are separated in time.

6. A system (10) as claimed in claim 1 or 2, wherein said at least one bipolar line comprises:
- a first bipolar line (42) configured to establish signal communication between said fire detection sensors (21) and said at least one fire data processing unit (22) and to supply power to said fire detection sensors (21),
- a second bipolar line (43), extending adjacent to said first bipolar line (42), said second bipolar line (43) being configured to establish signal communication between said RFID readers (31) and said at least one position data processing unit (32) and to supply power to said RFID readers (31).

7. A system (10) as claimed in claim 6, wherein said first bipolar line (42) and

said second bipolar line (43) are embedded in a single cable.

8. A system (10) as claimed in claim 6, wherein said first bipolar line (42) and said second bipolar line (43) are embedded in distinct cables.

9. A system (10) as claimed in any of claims from 1 to 8, wherein each RFID reader (31) is arranged directly adjacent to a respective fire detection sensor (21).

10. A system (10) as claimed in any of claims from 1 to 9 wherein, in each pair composed of an RFID reader (31) and its respective fire detection sensor (21), the fire detection sensor (21) is disposed within a first enclosure (24) and the RFID reader (31) is disposed in a second enclosure (34), said second enclosure (34) being separated from said first enclosure (24) and adjacent to said first enclosure (24).

11. A system (10) as claimed in any of claims from 1 to 9 wherein, in each pair composed of an RFID reader (31) and its respective fire detection sensor (21), the fire detection sensor (21) and the RFID reader (31) are disposed in a single enclosure.

12. A system (10) as claimed in any of claims from 1 to 11, wherein each RFID reader (31) is configured to generate a wake-up signal (Swake) able to activate an RFID tag (30) in a preset area (A) around said RFID reader (31), said preset area (A) corresponding to the lobe of the wake-up signal (Swake) generated by the RFID reader (31).

13. A system (10) as claimed in claim 12, wherein said wake-up signal (Swake) is a low-frequency signal, preferably in a range from 10 KHz to 1 MHz.

14. A system (10) as claimed in claim 12 or 13, wherein the maximum width (Lmax) of each lobe is smaller than or equal to the distance (D) between two contiguous RFID readers (31).

15. A system (10) as claimed in any of claims from 12 to 14, wherein the lobes of the wake-up signals (Swake) of two contiguous RFID readers (31) have such a shape as to avoid mutual overlapping.

16. A system (10) as claimed in any of claims from 12 to 15, wherein said wake-up signal (Swake) comprises data (PosR) representative of the position of the RFID reader (31) that generated said wake-up signal (Swake).

17. A system (10) as claimed in claim 16, wherein:
- each RFID tag (30) is associated with an identification code (ID),
- upon receiving a wake-up signal (Swake) by an RFID reader (31), each RFID tag (30) is configured to generate a tag signal (Stag), which comprises data representative of its own identification code (ID) and the data (PosR) representative of the position of the RFID reader (31) which generated said wake-up signal (Swake).

18. A system (10) as claimed in claim 17, wherein said tag signal (Stag) is a high-frequency signal, preferably in a range from 500 MHz to 10 GHz.

19. A system (10) as claimed in claim 17 or 18, wherein each RFID reader (31) is configured to receive a tag signal (Stag) generated by an activated RFID tag (30), and to send a position signal (Sp) to the at least one position data processing unit (32), wherein said position signal (Sp) comprises the identification code (ID) of the RFID tag (30) and the data (PosR) representative of the position of the RFID reader (31) that activated said RFID tag (30).

20. A system (10) as claimed in any of claims from 1 to 19, wherein each RFID reader (31) is placed in an enclosure and comprises a radiating antenna for radiating a wake-up signal (Swake) that can activate an RFID tag (30).

21. A system (10) as claimed in claim 20, wherein said antenna is located outside said enclosure.

22. A system (10) as claimed in claim 21, wherein said antenna is located outside said enclosure to radiate said wake-up signal (Swake) at a distance from said RFID reader (31).

23. A system (10) as claimed in any of claims from 1 to 22, wherein said at least one fire data processing unit comprises a first fire data processing unit (22) and a second fire data processing unit (23), said first and second fire data processing units (22, 23) being in signal communication with said plurality of fire detection sensors (21), and being able to receive the alarm signals (Sal) generated by said fire detection sensors (21).

24. A system (10) as claimed in any of claims from 1 to 23, wherein said at least one position data processing unit comprises a first position data processing unit (32) and a second position data processing unit (33), said first and second fire position data processing units (32, 33) being in signal communication with said plurality of RFID readers (31), and being able receive said position signals (Sp) generated by said RFID readers (31).

25. A system (10) as claimed in any of claims from 1 to 24, comprising a graphics interface (35) configured to display said position signals (Sp) in graphical form.

26. A method (10) for tracking the position of persons or items in facilities (1) having a plurality of rooms (2) for receiving a plurality of persons or items, using a system (10) as claimed in any of claims from 1 to 25, said method comprising the steps of:

- generating, by an RFID reader (31), a wake-up signal (Swake) that can activate an RFID tag (30) in a preset area (A) around said RFID reader (31), said preset area (A) corresponding to the lobe of the wake-up signal (Swake) generated by the RFID reader (31), wherein said wake-up signal (Swake) comprises data (PosR)

representative of the position of said RFID reader (31),

- receiving, by said activated RFID tag (30), said wake-up signal (Swake),

- generating, by said activated RFID tag (30), a tag signal (Stag) comprising data representative of its own identification code (ID) and the data (PosR) representative of the position of the RFID reader (31) which generated said wake-up signal (Swake),

- receiving, by an RFID reader (31), said tag signal (Stag) generated by said activated RFID tag (30) and sending a position signal (Sp) to said position data processing unit (32), wherein said position signal (Sp) comprises the identification code (ID) of said RFID tag (30) and the data (PosR) representative of the position of the RFID reader (31) that activated the RFID tag (30).

27. A method as claimed in claim 26, wherein said wake-up signal (Swake) is a low-frequency signal, preferably in a range from 10 KHz to 1 MHz.

28. A method as claimed in claim 25 or 26, wherein said tag signal (Stag) is a high-frequency signal, preferably in a range from 500 MHz to 10 GHz.

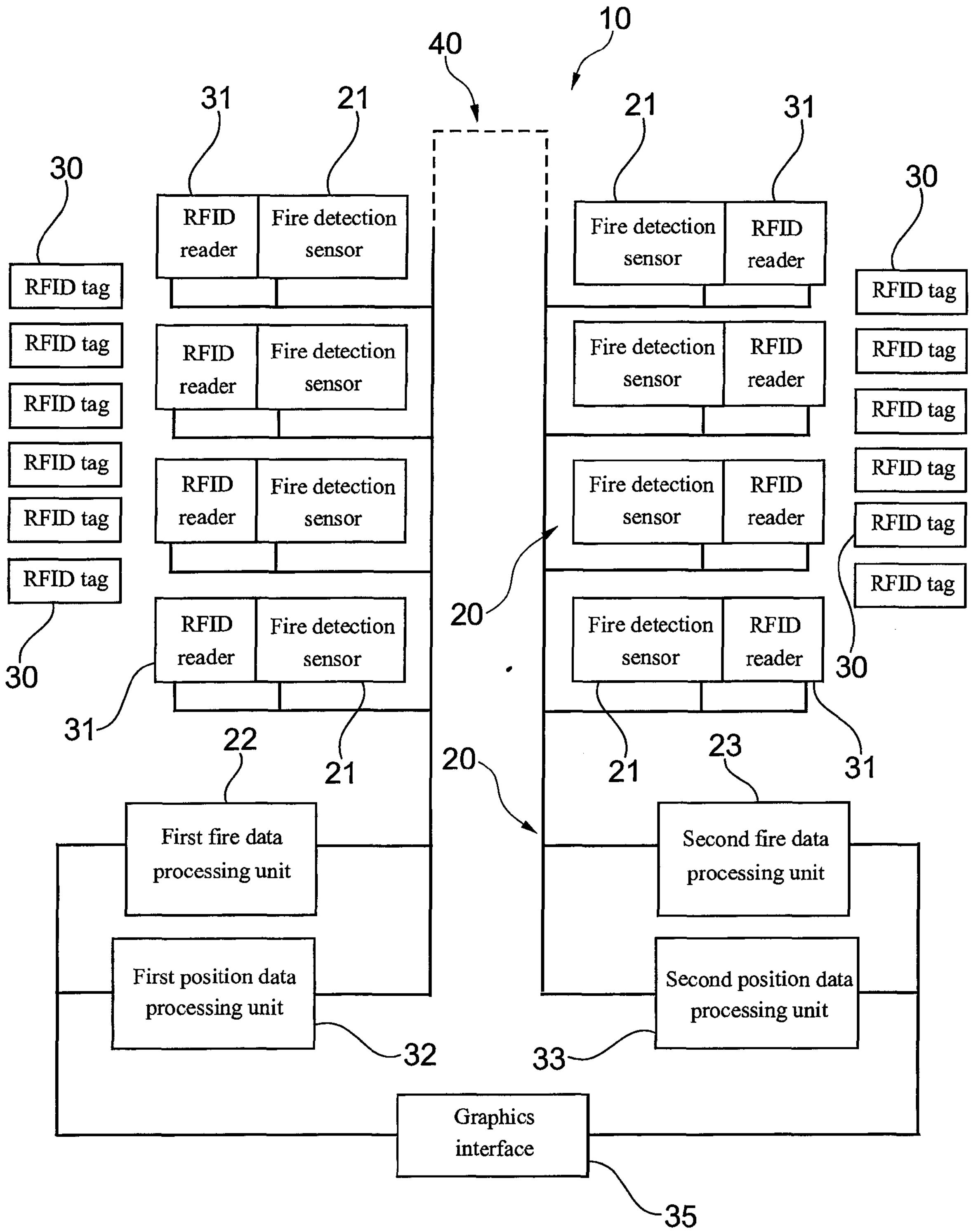
10
40
31
21
21
31
30
30
RFID reader
Fire detection sensor
Fire detection sensor
RFID reader
RFID tag
RFID tag
RFID tag
RFID tag
RFID tag
RFID tag
RFID tag
RFID tag
RFID tag
RFID tag
RFID tag
RFID tag
20
20
30
30
31
21
21
31
22
23
First fire data processing unit
Second fire data processing unit
First position data processing unit
Second position data processing unit
32
33
Graphics interface
35

FIG. 1

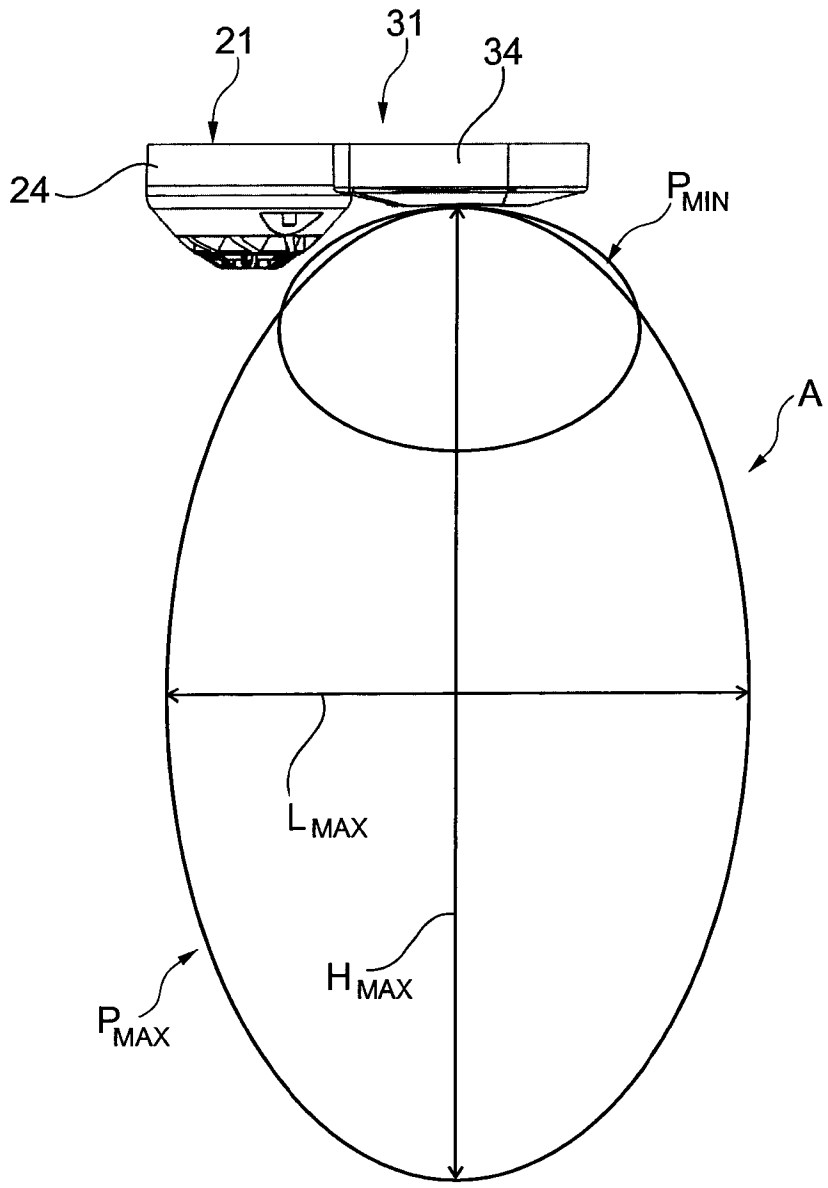

Fig. 2

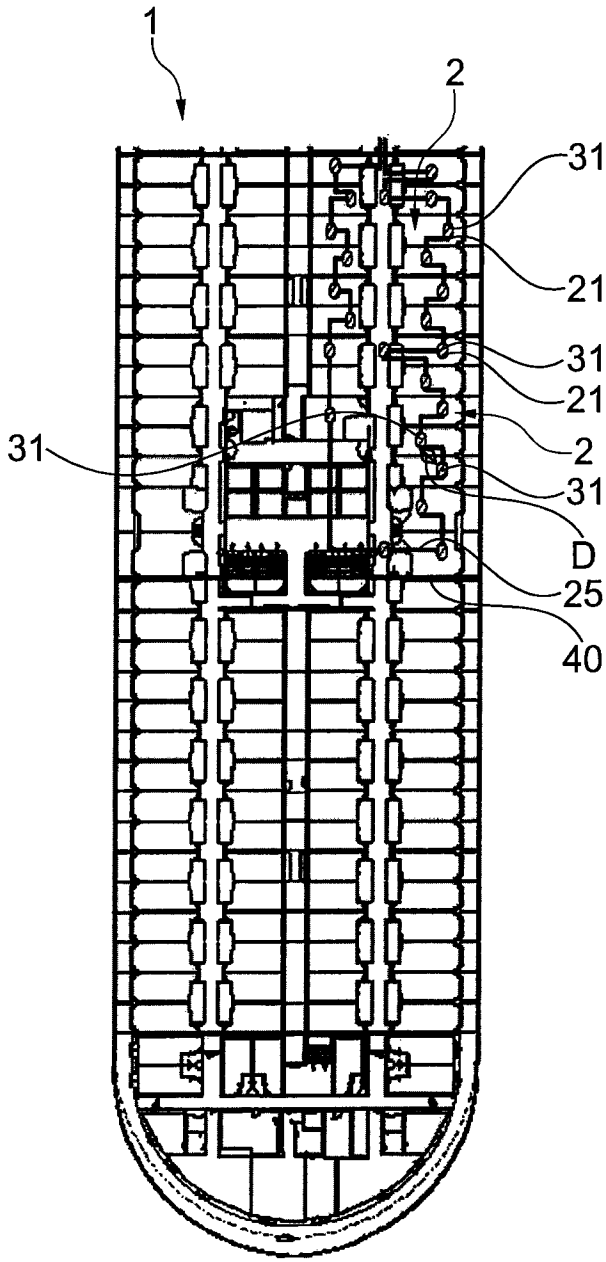

Fig. 3

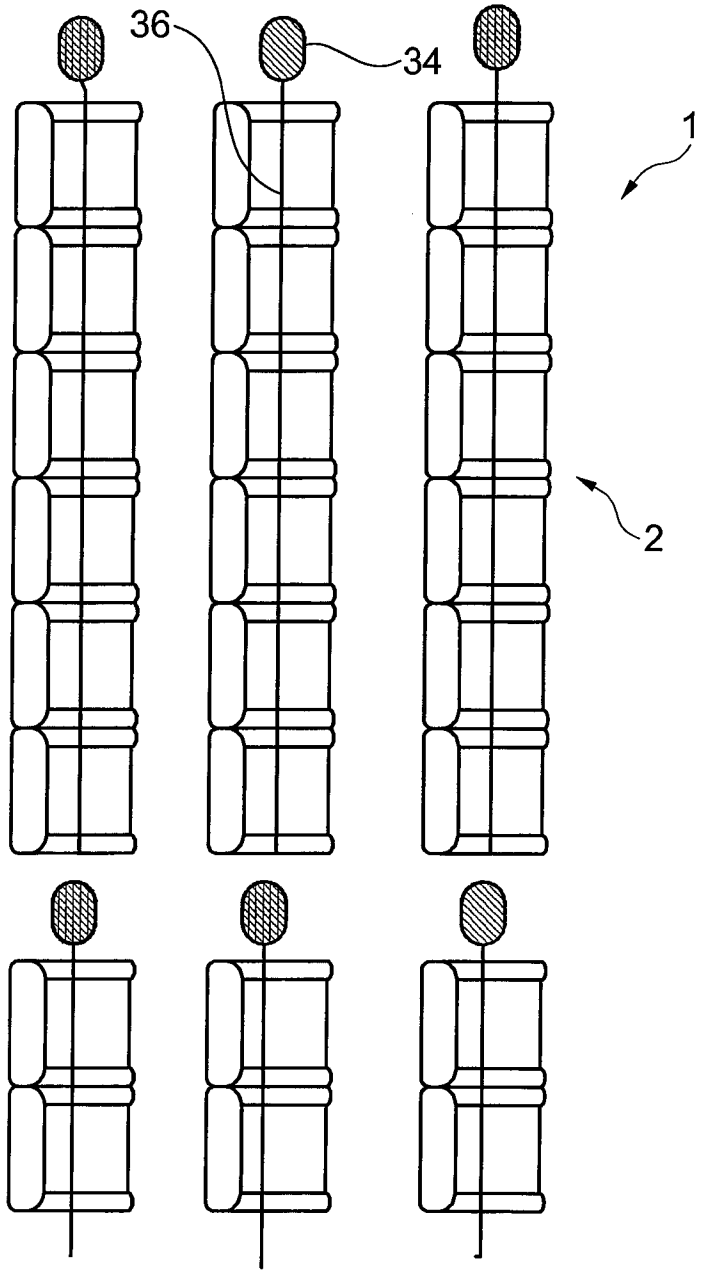

Fig. 4

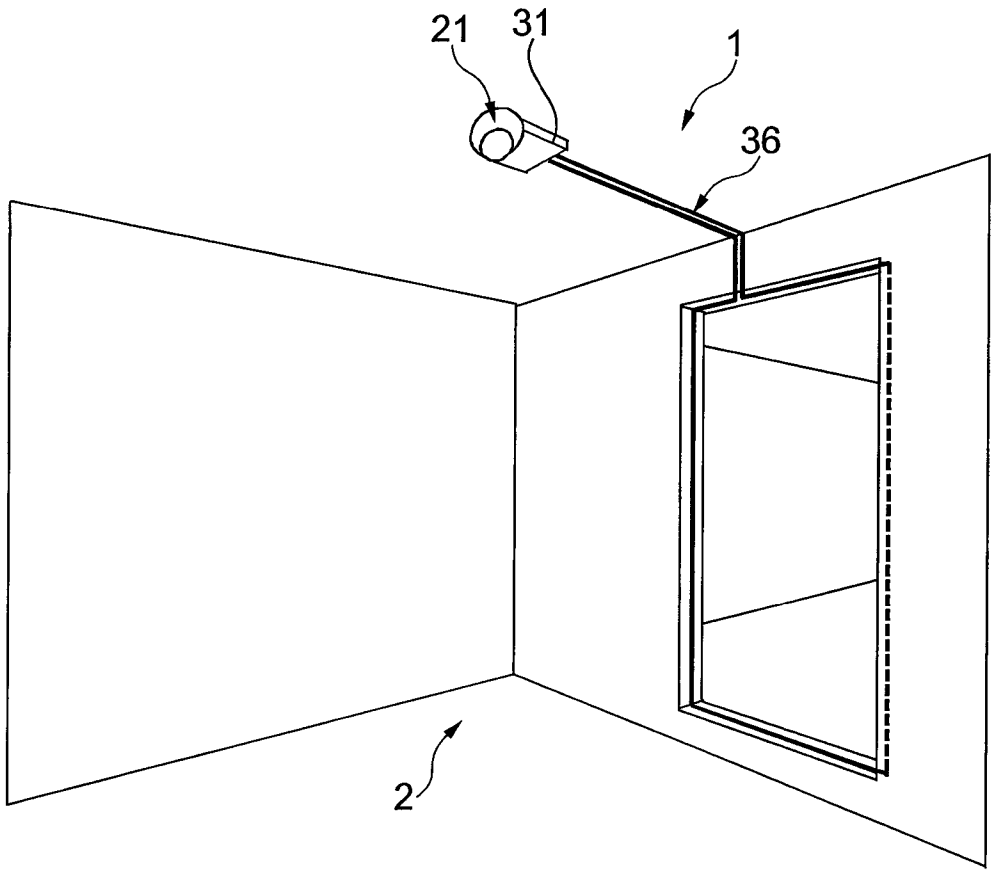

Fig. 5

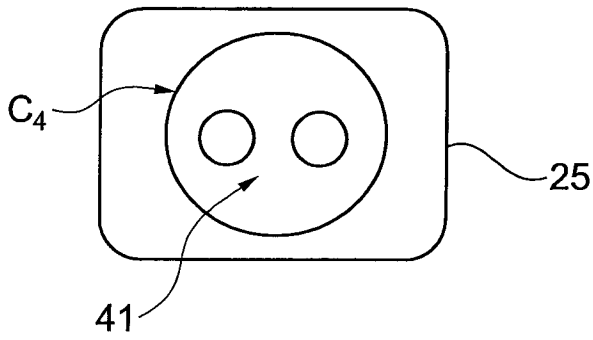

Fig. 6a

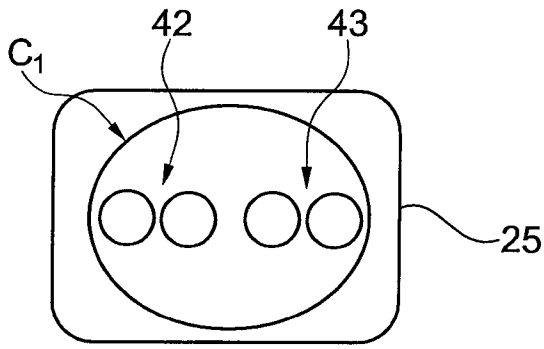

Fig. 6b

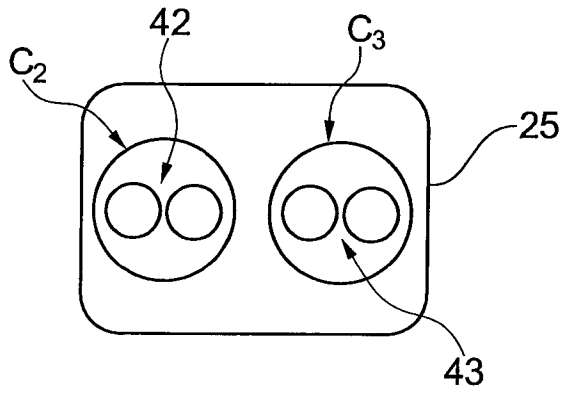

Fig. 6c

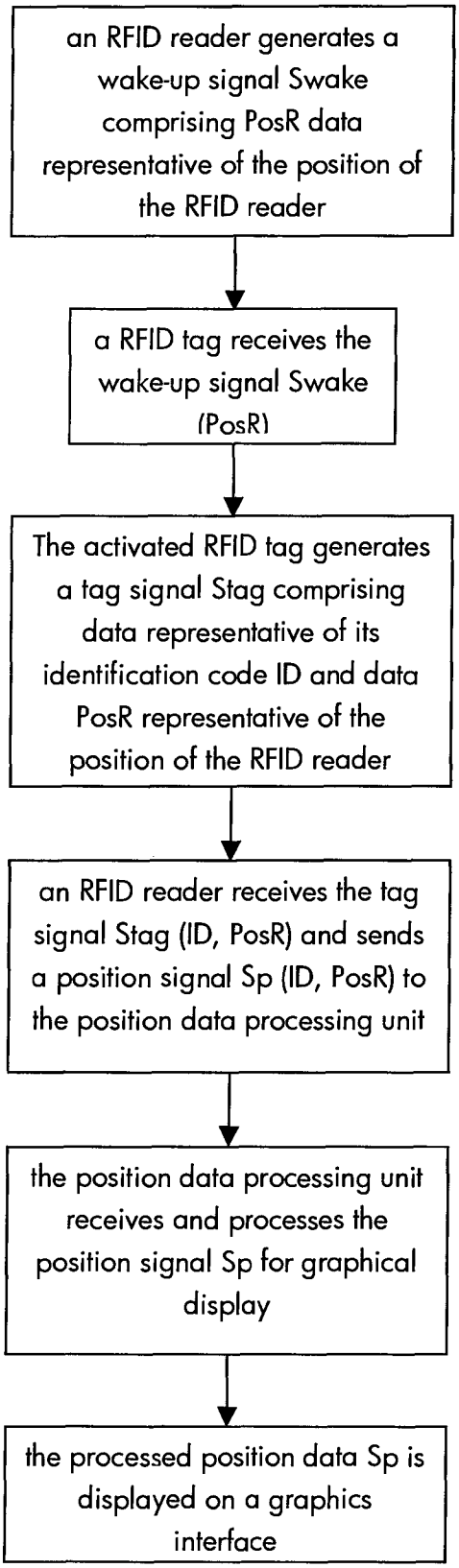
an RFID reader generates a wake-up signal Swake comprising PosR data representative of the position of the RFID reader
a RFID tag receives the wake-up signal Swake (PosR)
The activated RFID tag generates a tag signal Stag comprising data representative of its identification code ID and data PosR representative of the position of the RFID reader
an RFID reader receives the tag signal Stag (ID, PosR) and sends a position signal Sp (ID, PosR) to the position data processing unit
the position data processing unit receives and processes the position signal Sp for graphical display
the processed position data Sp is displayed on a graphics interface

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/IT2013/000224

A. CLASSIFICATION OF SUBJECT MATTER
INV. G08B17/00 G08B29/16 G06Q10/08 G08B25/04
ADD.

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)
G08B G06K G06Q

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 practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 03/019492 A1 (POLLARD JOHNNY [ZA]) 6 March 2003 (2003-03-06) page 1, line 16 - page 2, line 2 page 2, lines 10-12 page 3, lines 2-3,8-17 page 4, lines 11-19 page 5, lines 3-10 page 5, line 15 - page 6, line 4 page 6, lines 7-14 page 7, lines 4-5 page 9, lines 5-10 figures 1,2 ----- -/--	1-16, 20-25

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

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"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	Date of mailing of the international search report
30 April 2014	12/05/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Meister, Mark

1

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/IT2013/000224

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 814 092 A2 (HONEYWELL INT INC [US]) 1 August 2007 (2007-08-01) paragraph [0001] paragraphs [0010] - [0012] paragraphs [0015] - [0020] paragraphs [0056], [0057] paragraph [0059] paragraph [0062] paragraph [0065] figures 1-4	1-16, 20-25
X	KR 100 964 890 B1 (SEEUS PSP [KR]) 23 June 2010 (2010-06-23) paragraphs [0001] - [0003] paragraph [0008] paragraph [0011] paragraphs [0013], [0014] paragraph [0017] paragraph [0021] paragraphs [0025], [0026] paragraph [0028] paragraph [0030] paragraph [0032] figures 2,3	1-16, 20-25
A	US 4 555 695 A (MACHIDA HARUCHIKA [JP] ET AL) 26 November 1985 (1985-11-26) abstract; figure 1	1-28

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IT2013/000224

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 03019492 A1	06-03-2003	CA 2458200 A1	06-03-2003
		CN 1552046 A	01-12-2004
		EP 1419491 A1	19-05-2004
		HK 1068715 A1	06-02-2008
		US 2005003845 A1	06-01-2005
		WO 03019492 A1	06-03-2003
EP 1814092 A2	01-08-2007	CN 101013517 A	08-08-2007
		EP 1814092 A2	01-08-2007
		JP 2007207233 A	16-08-2007
		US 2007176770 A1	02-08-2007
KR 100964890 B1	23-06-2010	NONE	
US 4555695 A	26-11-1985	CH 658924 A5	15-12-1986
		DE 3418622 A1	06-12-1984
		GB 2141851 A	03-01-1985
		NO 841938 A	20-11-1984
		US 4555695 A	26-11-1985