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(54) **A STACK LIGHT FOR INDICATING A STATUS OF AN APPARATUS TO BE MONITORED**

(57) The invention pertains to a stack light (1) for indicating a status of an apparatus (8) to be monitored. The stack light (1) comprises at least two modules (2a to 2e, 3), wherein each module (2a to 2e, 3) comprises a wireless communication functionality, and wherein the modules (2a to 2e, 3) are configured to wirelessly communicate with each other.

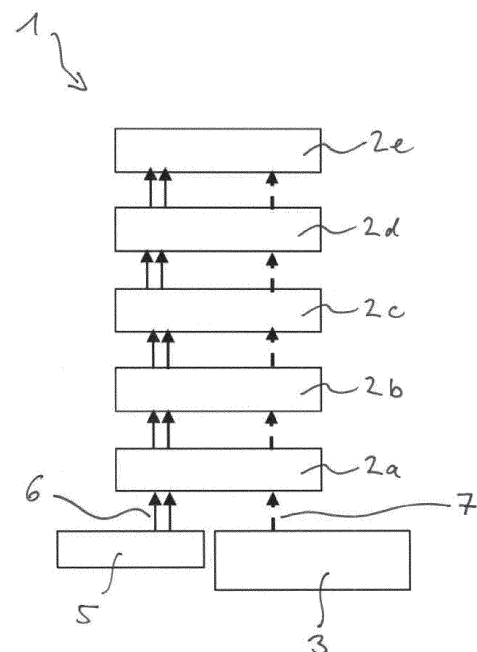


Fig. 2

Description

[0001] The invention pertains to a stack light for indicating a status of an apparatus to be monitored.

[0002] Stack lights, also known as signal towers or tower lights, are configured to indicate a status of an apparatus, machine or programmable logic controller (plc) which has to be monitored. The stack lights provide a combination of various signalling modules to generate a visual and/or audible signal depending on a status of the apparatus to be monitored. For example, stack lights comprise a combination of light emitting modules, e.g. light emitting diode (LED) modules, and acoustic modules for this purpose.

[0003] A disadvantage of conventional stack lights lies in the relatively complex wiring and electrical connection between the various modules. Also a functionality of a conventional stack light in terms of communication with other entities is often restricted.

[0004] It is, therefore, an object of the present invention to provide an enhanced stack light with improved functionality.

[0005] The object is solved by a stack light according to claim 1. Further implementations are described in the depending claims.

[0006] The stack light according to claim 1 is configured for indicating a status of an apparatus to be monitored and comprises at least two modules, wherein each module comprises a wireless communication functionality, and wherein the modules are configured to wirelessly communicate with each other.

[0007] Such a stack light provides the advantage over conventional solutions that communication signal wires inside the stack light are eliminated. In contrast, individual modules of the stack light may communicate wirelessly with each other with the aid of a respectively integrated wireless communication functionality provided within respective modules of the stack light. This makes a mechanical or electromechanical implementation of the stack light easier and may widen the functionality of the stack light and respective modules in terms of a communication between respective modules and/or a communication between various stack lights. The wireless communication functionality may be realized by a wireless communication device or component integrated in each module. The wireless communication device or component can for example be a radio frequency communication controller.

[0008] For a wireless communication between modules of the stack light any wireless communication protocol can be implemented. For example, a wireless communication can be implemented via Bluetooth or any other radio-frequency protocol. Optionally, depending on the application and configuration as desired by a user, various proprietary or open communication protocols can be implemented in connection with a wireless communication. For example, any industrial communication protocol which enables wireless communication between respective modules of the stack light can be used.

[0009] According to various embodiments, the modules of the stack light comprise a base module and at least one signalling module stacked on the base module. The at least one signalling module may be configured to generate a visual and/or audible signal depending on a wireless communication signal received from the base module.

[0010] Hence, the signalling module can be activated (switched), programmed or configured via a wireless communication controlled by the base module. For example, the base module may receive an input signal from a communication interface with an apparatus, machine or plc which is to be monitored by the stack light, wherein the base module, depending on the input signal, may generate a wireless communication signal to control a respective signalling module of the stack light via the wireless communication established between the base module and the respective signalling module. Furthermore, the stack light can be configured such that signal patterns or signal modes of a signalling module can be programmed or configured via a wireless communication signal by the base module. For example, the base module may control various flashing modes like continuous ON, flashing, strobe mode or the like of a respective signalling module via the wireless communication between the base module and the respective signalling module. Due to this, the stack light may provide an enhanced modularity in terms of programmable or configurable operation modes of individual signalling modules of the stack light by a wireless communication signal of the base module controlling the signalling modules of the stack light.

[0011] In this context, a visual signalling module can be a light emitting module, for example an LED module. Optionally, the signalling module may have a (programmable/configurable) multi-colour functionality.

[0012] In this context, an audible signalling module can be any module generating an audible sound signal and can for example be a kind of buzzer module.

[0013] According to various embodiments, the base module is configured as a wireless communication master device and the at least one signalling module is configured as a wireless communication slave device. Due to this, a reliable and conflictless wireless communication between the respective modules of the stack light can be guaranteed, even if the stack light provides for many various functional modules, in particular various signalling modules. The various functional modules, hence, are controlled as slave devices by the base module acting as master device of a wireless communication within the stack light.

[0014] In various embodiments, the stack light is configured to wirelessly communicate with the apparatus, machine or plc to be monitored. Such a wireless communication can be configured analogous to a wireless communication

between individual modules of the stack light. Alternatively, the wireless communication between the stack light itself and the apparatus to be monitored can be different to the wireless communication of individual modules within the stack light. A wireless communication of a stack light with an apparatus to be monitored together with a wireless communication of individual modules within the stack light has a synergetic effect in that a complete wireless end to end communication from a respective module of the stack light to a remote entity (apparatus to be monitored or remote monitoring entity) can be realised. This further enhances the flexibility, configuration possibility, and integration opportunity of a stack light within a whole prognostic/diagnostic network in the industrial field. For example, with connected stack lights of the kind explained above, connected factory solutions (Internet of Things connected factory solutions) can be realised, wherein respective stack lights can be flexibly configured and controlled with their respective modules, may interchange and share analytics data and indicate various diagnostic data within a connected factory network between various apparatus, machines or plcs.

[0015] Alternatively or additional to a wireless communication between a stack light and an apparatus to be monitored (and any other remote entity), a wired communication interface between respective components (stack light, apparatus to be monitored, and any other remote entity) can be provided. For example, the stack light can be connected with other stack lights, apparatus to be monitored or any other remote entity via any industrial wired protocol like Controller Area Network (CAN), SmartWire DT, Ethernet, Ethercat, ASi, IOLink, Profibus, and so on. Nevertheless, due to a wireless communication between individual modules of one single stack light, the stack light can be easily implemented and can be modular in terms of a communication configuration of respective modules of the stack light, as explained above. In optional implementations, wired communication protocols of the kind mentioned above can be adapted, where appropriate, to be implemented as wireless communication protocols or can be adapted and included as protocol stack in any wireless communication protocol.

[0016] In various embodiments, the stack light can be configured to evaluate a received signal pattern of the apparatus, machine or plc to be monitored and to predict a diagnostic feature of the apparatus to be monitored. Due to this, a prognostic/diagnostic functionality of the stack light can be configured. The received signal pattern of the apparatus to be monitored can be, for example, a time course of a voltage and/or current signal communicated to the stack light by the apparatus to be monitored. In additional or alternative implementations, the stack light makes itself a diagnose of input data, monitors outputs of the apparatus which is driving the stack light or gets diagnose data from the apparatus or plc and sends the diagnose data to a remote server. For such implementations, for example, a wireless or wired communication interface of the kind mentioned above between the stack light and the apparatus to be monitored can be used. In alternative or additional implementations, the received signal pattern of the apparatus to be monitored can be a voltage and/or current signature or any other electric or electronic signature of the apparatus to be monitored, which can be evaluated by the stack light in order to predict a diagnostic feature of the apparatus to be monitored. For example, the received signal pattern of the apparatus to be monitored can be evaluated in the stack light and may indicate an error state of the apparatus to be monitored at a future point in time.

[0017] Hence, by the mentioned prognostic/diagnostic functionalities of the stack light not only a signalization of a present status of an apparatus to be monitored can be provided by the stack light, but also any potential future status of the apparatus can be predicted and eventually indicated by the stack light. For this purpose, the stack light has a certain implemented intelligence for evaluating the received signal pattern of the apparatus to be monitored. Beyond, due to be explained wireless communication between individual modules of the stack light, a communication of certain states and signals between respective modules of the stack light can be easily implemented.

[0018] The benefits to an end-user of the stack light or an arrangement of connected stack lights lies in the knowledge of a potential failure of the apparatus on time or even before the failure occurs. This may reduce a turnaround time for fixing problems of an apparatus to be monitored and increases the efficiency due to predictive maintenance achieved by the above explained enhanced functionality. Moreover, data collected, evaluated and eventually indicated by the stack light and its respective modules can be used for analytics purposes. For example, any data collected by one or more connected stack lights can be evaluated and analysed in a remote monitoring and analysis entity connected with the stack lights in a connected factory environment.

[0019] In the following, further advantageous aspects of a stack light are explained. These aspects can be implemented on their own in a stack light or can be implemented in combination with further features, aspects and implementations of a stack light as explained above.

[0020] According to a first aspect, a stack light may comprise one or more modules comprising at least one light emitting module as visual signalling module, wherein the stack light comprises an ambient light sensor and is configured to adaptively control the brightness of the at least one light emitting module depending on the ambient light intensity sensed by the ambient light sensor. This has the advantage, that the brightness of the at least one light emitting module can be controlled such that the visual signalling module may provide a reliable visual indication of a certain status in various ambient light situations such that a signalisation of the visual signalling module can be well received by a user. In an optional combination with one or more of the features, aspects and implementations of a stack light as explained above, a control signal for controlling the brightness of the light emitting module can be wirelessly communicated to the

light emitting module, for example by a base module controlling the light emitting module via a wireless communication.

[0021] According to a second aspect, a stack light may comprise one or more modules comprising at least one display module with an electronic display as visual signalling module, wherein the electronic display is a foldable display arranged on an outer periphery of the at least one display module. The foldable display may for example be an organic light emitting diode display (OLED). The advantage of a foldable display lies in an exact and form-fit arrangement of the display on an outer periphery, for example circular or partly circular periphery, of the at least one display module. In this way, a display module can be provided in the stack light which comprises an enhanced display functionality for indicating or signalling information to a user. In an optional combination with one or more of the features, aspects and implementations of a stack light as explained above, a connection and control of the display module according to this aspect can be realised by a wireless communication interface between the display module and at least one further module of the stack light, for example a base module of the kind explained above. In this way, the display module can be wirelessly controlled.

[0022] According to a third aspect a stack light may comprise one or more modules comprising at least one light emitting module as a visual signalling module, wherein the at least one light emitting module is configured with an array of light emitting diodes (LED) and provides a heat pipe to dissipate heat from the array of LEDs. The array of LEDs can, for example, be arranged on a printed circuit board within the light emitting module. The heat pipe or generally any heatsink can be arranged to dissipate heat from the printed circuit board with the array of LEDs mounted thereon. In this way, high-power/high-wattage LEDs can be configured within the light emitting module of the stack light.

[0023] According to a fourth aspect, a stack light may comprise at least two modules that are detachably connected to each other, wherein each module provides at least one of a visual, haptic or acoustic feature corresponding to a respective visual, haptic or acoustic feature of another module for indicating an assembled or disassembled state of each module. This makes an assembly or disassembly of two modules of the stack light very easy. The visual, haptic or acoustic feature may help a customer to locate two modules with regard to their mutual mounting positions such that the modules can be assembled easily and effortlessly. Moreover, a haptic feature of a respective module may provide a locking feel to a customer. Optionally, it may make the assembly sturdy. The visual, haptic or acoustic feature of a corresponding module can be realised for example by any protrusion, indentation, notch, cam, etc.

[0024] Advantageously, a stack light of the kind explained above can be used within an arrangement of at least two stack lights, wherein the stack lights are configured according to the above explanations and wherein the stack lights are configured to wirelessly communicate with each other and/or with a remote monitoring entity. For example, such an arrangement can be configured within a factory or any other industrial or economic environment in order to provide a reliable and nevertheless easy to implement prognostic/diagnostic network as explained above.

[0025] In the following, the invention is explained in more detail by means of embodiments with the aid of several drawings.

Figure 1 shows an exemplary embodiment of a stack light,

Figure 2 shows a schematic diagram of signal flows of an exemplary embodiment of a stack light according to the invention,

Figure 3 shows a schematic diagram of an exemplary implementation of a network with various stack lights according to the invention,

Figure 4 shows an exemplary embodiment of two modules of a stack light according to the invention in a first assembly state,

Figure 5 shows the two modules according to Figure 4 in a second assembly state,

Figure 6 shows the two modules according to Figure 4 in a third assembly state, and

Figure 7 shows a further perspective view of one of the two modules according to Figure 4.

[0026] Figure 1 shows an exemplary embodiment of a stack light 1. The stack light 1 comprises various modules 2a, 2b, 2c, 2d, and 2e as well as a module 3 which are stacked along a main axis of the stack light 1 on a stand 4. The modules 2a, 2b, 2c, 2d, and 2e can be so-called signalling modules that are configured to generate a visual and/or audible signal. For example, the signalling modules 2a to 2c are light emitting modules, e.g. configured as LED modules. The modules 2d, 2e can be a combined visual and audible signalling module comprising a light emitting module 2d and an audible signal module 2e, for example a buzzer module. There is no restriction regarding the number of modules. The number of five modules according to this embodiment is exemplary.

[0027] The module 3 is configured according to this embodiment as a base module. According to this embodiment, the base module serves the purpose of controlling the other modules 2a to 2e such that depending on a control signal or other communication signal transmitted from the base module 3 to one of the other modules 2a to 2e, the respective module 2a to 2e be controlled, for example activated/switched, programmed or configured. Hence, the base module 3 is configured as a kind of master device for controlling the further modules 2a to 2e which are configured as kind of slave devices. In an alternative embodiment of the stack light 1 the base module is implemented as an integrated part of the stand/foot 4.

[0028] The stand 4 is configured to provide a mechanical mount for mounting the stack light 1, for example on an apparatus whose status is to be monitored by the stack light 1. The apparatus can be any apparatus, machine or plc in the industrial field, for example. The signalling modules 2a to 2d can provide different lightning colours. For example, the various modules 2a to 2d may provide different colours like red, yellow, blue, green, and amber. Optionally, one or more of the modules 2a to 2d may provide a multicolour functionality depending on the application of the stack light 1. The acoustic module 2e may provide as well different acoustic patterns that may be pre-programmable. Hence, with the various signalling modules 2a to 2e, the stack light 1 may indicate different status of an apparatus to be monitored by controlling an activation or deactivation of various modules 2a to 2e in order to provide determined signalling patterns depending on an ON/OFF mode of the respective modules 2a to 2e.

[0029] As explained above, a control of the modules 2a to 2e is performed with the aid of the base module 3 acting as a master device for the slave devices 2a to 2e. Optionally, also the base module 3 may provide a signalling functionality as explained above in the context of the modules 2a to 2e.

[0030] A power supply for the stack light 1 can be configured in the stand 4 or optionally in the base module 3. Hence, electric power can be supplied through the stand 4 or the base module 3 respectively to the various modules 2a to 2e in order to supply the electric components 3 and 2a to 2e of the stack light 1 with electric energy.

[0031] Optional to an activation, programming or configuration functionality of the base module 3, the stack light 1 may provide one or more switches that can be operated by a user. The one or more switches may for example serve the purpose of manually activating or deactivating one or more of the modules 3 or 2a to 2e. Optionally, the one or more switches may also serve the purpose of configuring or programming different operation modes, for example signalling modes like continuous ON, flashing, strobe mode, etc. of the signalling modules 2a to 2e. According to one exemplary implementation, one single switch may be integrated in the stand 4 or in the base module 3 for configuring all of the signalling modules 2a to 2e with different flashing modes. In an alternative implementation one or more of the modules 3 and/or 2a to 2e may provide a switch for controlling the respective individual module. For this purpose, the user may disassemble the stack light 1 into the individual modules in order to switch each module with a respective switch to a desired operation mode accordingly.

[0032] Alternatively or additionally to the switch implementations, as explained above, a control of any signalization functionality (or other functionality) of the stack light 1 is realised by receiving input signals by the stack light 1 such that the base module 3 may control (activate, configure or program) the various signalling modules 2a to 2e depending on a respective input signal received from an apparatus to be monitored via the stack light 1.

[0033] The stack light 1 may provide a wired or wireless communication interface for a communication with the apparatus to be monitored. Via this communication interface the stack light 1 may receive input signals of the apparatus to be monitored and/or may provide the apparatus to be monitored with further data coming from the stack light 1. A wired communication may be configured according to any industrial standard communication protocol like CAN, SmartWire DT, Ethernet, Ethercat, ASi, IOLink, Profibus, etc. A wireless communication interface may for example be configured as a Bluetooth or any other radio-frequency (RF) communication protocol. A wireless communication can also be combined with a wired communication depending on the application. Optionally, standard industrial protocols used for wired communication can also be implemented in a wireless context, if appropriate and suitable according to the desired application.

[0034] Additionally to the features as explained above, the stack light 1 according to the embodiment of figure 1 also provides a wireless communication between the respective modules 3 and 2a to 2e. This means that all modules 3 and 2a to 2e communicate wirelessly with each other such that any communication signal wire or respective wired or solid communication connections inside the modules can be eliminated. In this way, the stack light 1 can be easily implemented without the need for any communication signal wires inside and between respective modules 3 and 2a to 2e. Hence, each module 3 and 2a to 2e can be easily implemented. A control of the various modules 2a to 2e by the base module 3 is performed through wireless communication between the respective modules.

[0035] The stack light 1 according to the embodiment of figure 1 can be implemented as one single component with the segments/modules 2a to 2e, 3 and 4 un-detachably fixed to each other. In an alternative implementation, the stack light 1 according to the embodiment of figure 1 can be implemented such that the various segments/modules 2a to 2e, 3 and/or 4 are detachably connected to each other. The latter implementation has the advantage, that the stack light 1 can be designed as modular stack light 1 and can be adapted to any desired configuration. Due to the fact that the modules 2a to 2e wirelessly communicate with the base module 3, a very modular and easily configurable stack light 1

is provided. This also makes mounting and assembling respective modules very easy.

[0036] In various implementations of the stack light 1 according to figure 1, one or more of the modules 2a to 2e or 3 may provide one or more of the following features: a foldable display (for example OLED) installed on the periphery of the respective module; a heat pipe for dissipating heat from the respective light source, for example an array of LEDs, wherein the heat pipe can be arranged on a printed circuit board accommodating the array of LEDs.

[0037] In various implementations, the stack light 1 according to figure 1 may also provide one or more ambient light sensors for sensing the ambient light, wherein the stack light 1 (for example with the aid of the base module 3) is configured to adaptively control the brightness of at least one of the signalling modules 2a to 2d depending on the ambient light intensity sensed by the one or more ambient light sensors. For example, an ambient light sensor may be integrated into the stand 4 or the base module 3 or at the top of the stack light 1.

[0038] With regards to optional implementations of the kind mentioned above, a communication of control signals between respective modules 3 and 2a to 2e is advantageously performed via the wireless communication between the respective modules 3 and 2a to 2e as explained above.

[0039] Figure 2 shows a schematic diagram of signal flows in an exemplary embodiment of a stack light 1 as exemplarily shown in figure 1. Figure 2 schematically illustrates the different modules 3 and 2a to 2e and a separate power supply unit 5 for a power supply of the respective modules 2a to 2e. According to the implementation of figure 2, the power supply unit 5 is separate to the base module 3 and only serves the purpose of a power supply of the respective signalling modules 2a to 2e. Optionally, the power supply unit 5 can also be integrated into the base module 3 and/or additionally supply the base module 3 with electric power besides the further modules 2a to 2e.

[0040] As illustrated in figure 2, the power supply unit 5 provides electric power to the modules 2a to 2e via power supply lines 6 that can be configured as electric wires and respective electromechanical connections between the power supply unit 5 and the electric chain of modules 2a to 2e. For example, a dc power supply can be furnished to the modules 2a to 2e via the two power supply lines 6 according to Figure 2. Hence, electric power is daisy-chained from the power supply unit 5 to the respective signalling modules 2a to 2e. As explained above in the context of figure 1, the modules 2a to 2e are stacked together and are mechanically connected such that also an electromechanical connection for power supply by the power supply lines 6 is established.

[0041] In contrast to the solid power supply lines 6, a communication between the base module 3 and the signalling modules 2a to 2e is performed via wireless communication through a wireless communication interface or signals 7. In this way, the base module 3 can wirelessly communicate with each of the modules 2a to 2e in order to provide a kind of master-slave communication as explained above. Optionally, also the modules 2a to 2e may wirelessly communicate to each other via the wireless communication 7. Figure 2 illustrates an easy implementation and configuration of the stack light 1 with regard to any wiring, wherein only power supply lines 6 have to be provided as solid connections in the stack light 1. Any other signal communication and information exchange is performed via the wireless communication signals 7 between the various modules.

[0042] Figure 3 shows a schematic diagram of an exemplary implementation of a network with various stack lights according to the above explanations. Figure 3 illustrates multiple stack lights 1a to 1d which can be configured according to the above explanations with regard to figures 1 and 2. Each stack light 1a to 1d is coupled with a respective apparatus 8a to 8d which has to be monitored via the respective stack light. The stack lights 1a to 1d and/or the respective apparatus 8a to 8d are connected through wireless communication connections 9 and/or through wired communication connections 10. The wireless communication connection 9 can be any radio-frequency connection, like Bluetooth, etc. The wired communication connection 10 can be any of industrial standard communication protocols of the kind explained above.

[0043] Additionally, also a remote monitoring entity 11 is integrated into the network according to figure 3, wherein the remote monitoring entity 11 provides a communication unit 12 which can receive and transmit information from and between the connected entities in the network. The remote monitoring entity 11 can for example be a monitoring server for surveillance of the stack lights 1a to 1d and/or the apparatus 8a to 8d.

[0044] Additionally, a portable device 13 can be integrated into the network which can also wirelessly communicates with the further entities. For example, the portable device 13 can be a hand-held monitoring device, smartphone, tablet etc. The portable device 13 may provide a monitoring and/or configuration software application for controlling, configuring or programming entities in the connected network. For example, a respective status of an apparatus 8a to 8d and/or of a stack light 1a to 1d can be monitored and analysed via the portable device 13 and the respective mobile software application.

[0045] Each stack light 1a to 1d can communicate with their respective apparatus, machine or plc 8a to 8d for getting information about the respective apparatus, for example for getting machine health data of the respective apparatus. In particular, each stack light 1a to 1d can detect a voltage and/or current signature of the respective apparatus 8a to 8d for collecting prognostics/diagnostics information. In this way, each stack light 1a to 1d may predict a status or failure of the respective apparatus 8a to 8d. Such information can be distributed through the connected network to other entities in order to monitor, collect and analyse the transmitted data. Due to a configuration of each stack light 1a to 1d advantageously with a wireless communication between respective modules of a stack light as explained in the context of

figures 1 and 2 above, an end to end wireless communication from each module of a respective stack light 1a to 1d to any other entity, for example 11 or 13, in the connected network can be realised. Therefore, a very modular and fine tuning configuration of the whole network can be realised. In this way, too, a very modular and easy to implement Internet of Things network can be realised. The benefits for an end-user lie in the knowledge of a failure on time or before the failure occurs through collected prognostics/diagnostics data indicated and/or collected through the various stack lights 1a to 1d and eventually analysed in further entities 11 or 13. This means a less turnaround time for failure fixing and an increase of an efficiency due to predictive maintenance possibilities. In this way connected factory solutions with enhanced analytics functionalities can be realised. Additionally, any collected data may be sent to a cloud service (not shown) for further analysis purposes.

[0046] Figure 4 shows an exemplary embodiment of two modules 2a and 3 of a stack light 1 as explained above in a first assembly state. Each of the modules 2a and 3 provides an indication 14a and 14b which can be a visual, haptic and/or acoustic feature of the respective module 2a and 3. The indications 14a and 14b provide mounting features corresponding to each other for indicating an assembled or disassembled state of the modules 2a and 3. According to figure 4, both modules 2a and 3 are disassembled from each other. For assembling both modules, the modules have to be brought together, wherein module 2a can be stacked on module 3 as depicted in figure 5.

[0047] Figure 5, therefore, illustrates a second assembly state of both modules 2a and 3 brought together. In this state, both indications 14a and 14b are aligned to each other, thereby marking the second assembly state to a user. For fixing both modules 2a and 3 together, module 2a can be rotated in clockwise direction to get assembled with module 3 as illustrated in figure 6.

[0048] Figure 6, therefore, shows a third assembly state of both modules 2a and 3 which now are fixed together. The third assembly state is indicated by the indications 14a and 14b, wherein both indications are located at different circumferential positions to each other.

[0049] Hence, a configuration according to figures 4 to 6 helps a customer to locate two modules to be assembled and to provide an effortless assembly which indicates to a user every assembly state from a disassembled state to an assembled state and vice versa. This may add a user in configuring a modular stack light 1 with detachably assembled modules 3 and 2a to 2e according to the explanations with regard to figure 1 above.

[0050] Figure 7 shows a further perspective view of the module 3 according to figures 4 to 6. Figure 7 illustrates a further mounting feature 15 provided at a circumference of an upper part of the module 3 besides the indication 14b that is provided at the circumference of a lower part of the module 3. The mounting feature 15 provides a kind of cam profile which provides a kind of haptic feature for a customer when locking both modules 2a and 3 together as illustrated and explained with regard to figure 6. Hence, the mounting feature 15 provides a kind of locking feel and haptic feedback to a customer and also makes the assembly of both modules 2a and 3 sturdy.

[0051] All aspects, features and implementations explained with regard to a stack light 1 or a connected configuration of several stack lights 1a to 1d as explained above can be configured separate to each other or in combination. All embodiments shown and explained with regard to figures 1 to 7 are only exemplarily chosen.

List of reference numerals

[0052]

1	stack light
1a, 1b, 1c, 1d	stack light
2a, 2b, 2c, 2d, 2e	modules of stack light
3	base module of stack light
4	stand
5	power supply unit
6	power supply line
7	wireless communication signal
8a, 8b, 8c, 8d	apparatus to be monitored
9	wireless communication connection
10	wired communication connection
11	remote monitoring unit
12	communication unit
13	portable device
14a, 14b	mounting feature
15	mounting feature

Claims

1. A stack light (1) for indicating a status of an apparatus (8) to be monitored, the stack light (1) comprising at least two modules (2a to 2e, 3), wherein each module (2a to 2e, 3) comprises a wireless communication functionality, and wherein the modules (2a to 2e, 3) are configured to wirelessly communicate with each other.
2. The stack light (1) according to claim 1, wherein the modules (2a to 2e, 3) comprise a base module (3) and at least one signalling module (2a to 2e) stacked on the base module (3), wherein the at least one signalling module (2a to 2e) is configured to generate a visual and/or audible signal depending on a wireless communication signal (7) received from the base module (3).
3. The stack light (1) according to claim 2, wherein the base module (3) is configured as a wireless communication master device and the at least one signalling module (2a to 2e) is configured as a wireless communication slave device.
4. The stack light (1) according to one of claims 1 to 3, wherein the stack light (1) is configured to wirelessly communicate with the apparatus (8) to be monitored.
5. The stack light (1) according to one of claims 1 to 4, wherein the stack light (1) is configured to evaluate a received signal pattern of the apparatus (8) to be monitored and to predict a diagnostic feature of the apparatus (8) to be monitored.
6. The stack light (1) according to one of claims 1 to 5, wherein the modules (2a to 2e, 3) comprise at least one light emitting module (2a to 2d) as visual signalling module and wherein the stack light (1) comprises an ambient light sensor and is configured to adaptively control the brightness of the at least one light emitting module (2a to 2d) depending on the ambient light intensity sensed by the ambient light sensor.
7. The stack light (1) according to one of claims 1 to 6, wherein the modules (2a to 2e, 3) comprise at least one display module with an electronic display as visual signalling module (2a to 2e), wherein the electronic display is a foldable display arranged on an outer periphery of the at least one display module.
8. The stack light (1) according to one of claims 1 to 7, wherein the modules (2a to 2e, 3) comprise at least one light emitting module (2a to 2d) as visual signalling module and wherein the at least one light emitting module (2a to 2d) is configured with an array of light emitting diodes and provides a heat pipe to dissipate heat from the array of light emitting diodes.
9. The stack light (1) according to one of claims 1 to 8, wherein the modules (2a to 2e, 3) are detachably connected to each other and wherein each module (2a to 2e, 3) provides at least one of a visual, haptic or acoustic feature (14a, 14b, 15) corresponding to a respective visual, haptic or acoustic feature (14a, 14b, 15) of another module (2a to 2e, 3) for indicating an assembled or disassembled state of each module (2a to 2e, 3).
10. An arrangement of at least two stack lights (1a, 1b, 1c, 1d), wherein the stack lights (1a, 1b, 1c, 1d) are configured according to one of claims 1 to 9 and wherein the stack lights (1a, 1b, 1c, 1d) are configured to wirelessly communicate with each other and/or with a remote monitoring entity (11, 13).

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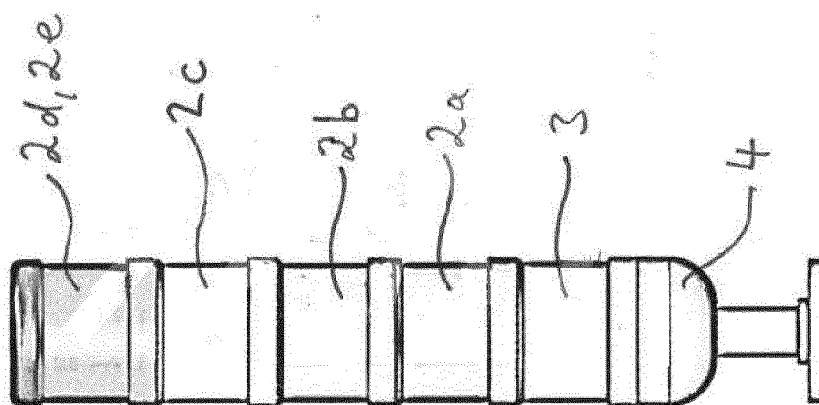


Fig. 1

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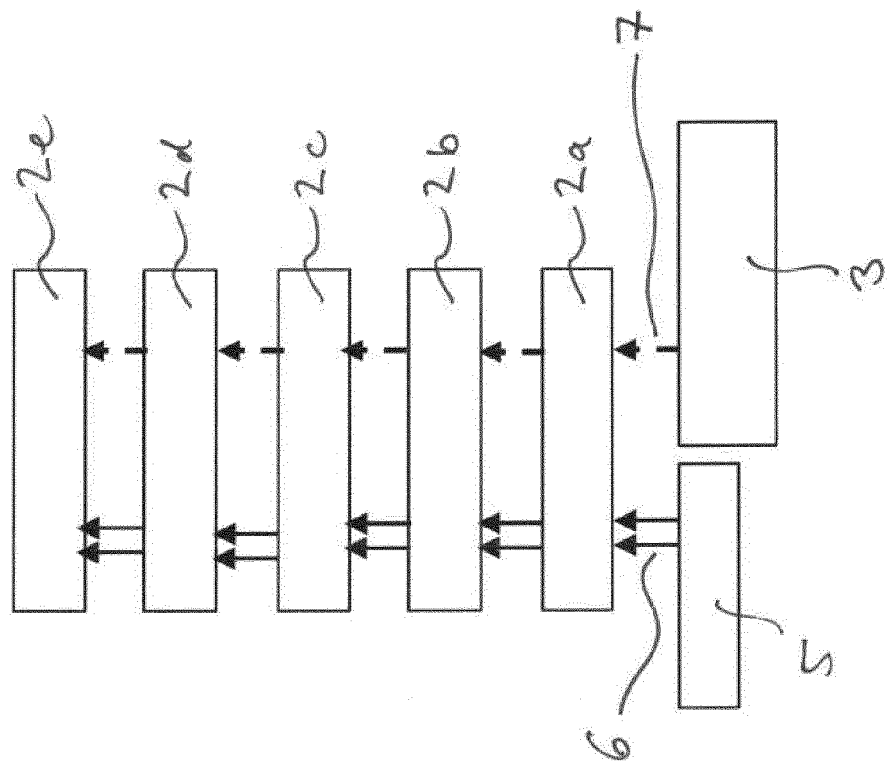


Fig. 2

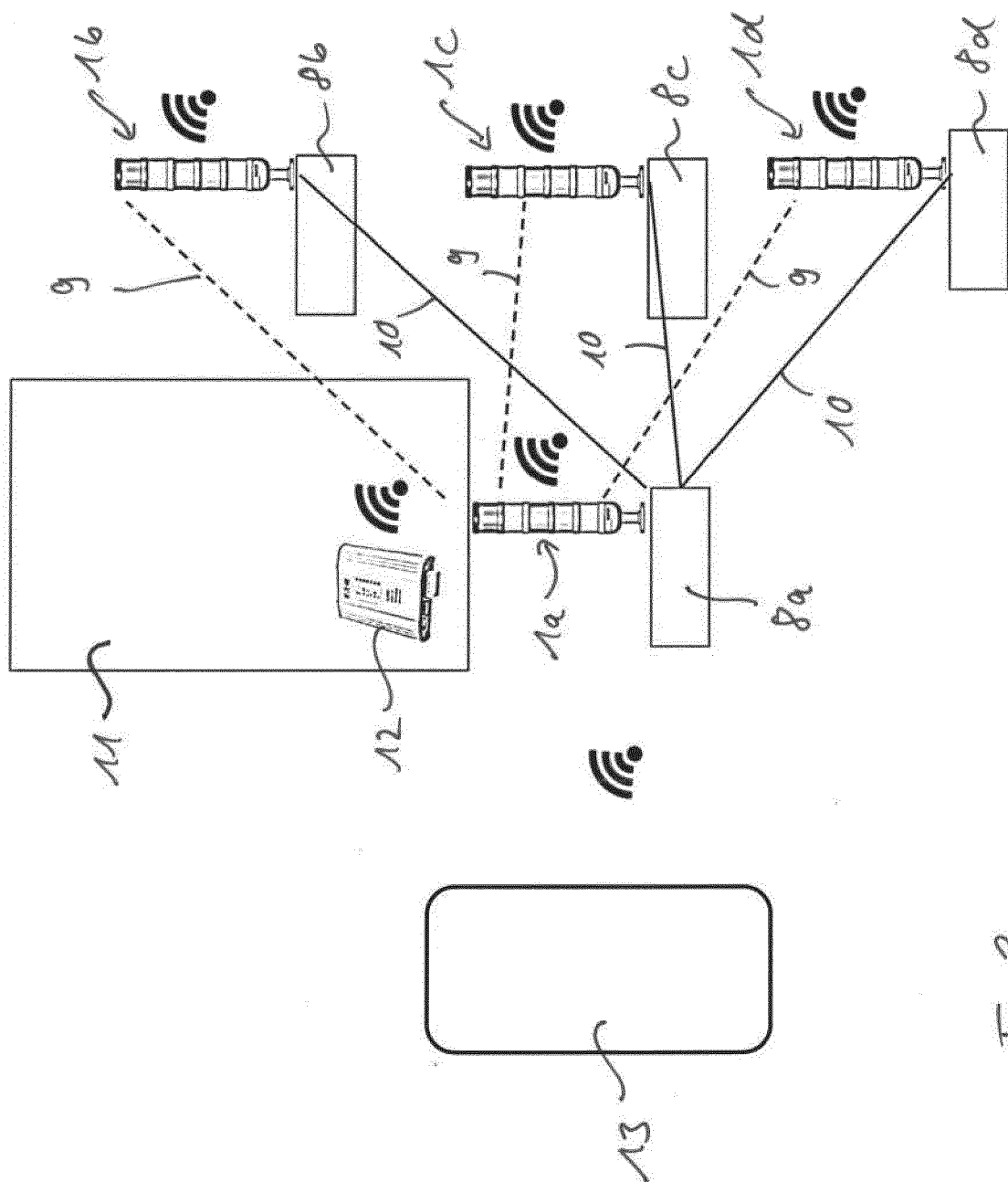


Fig 3

Fig. 5

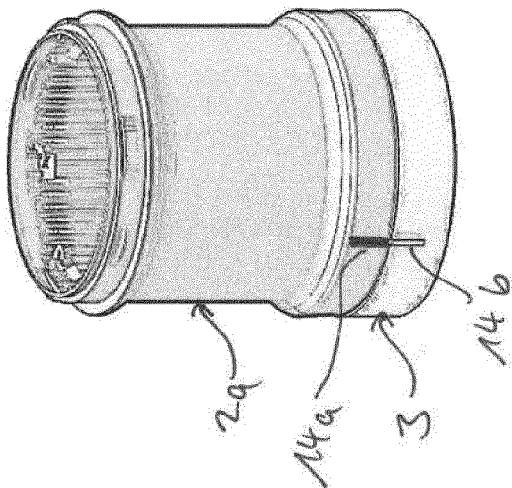


Fig. 6

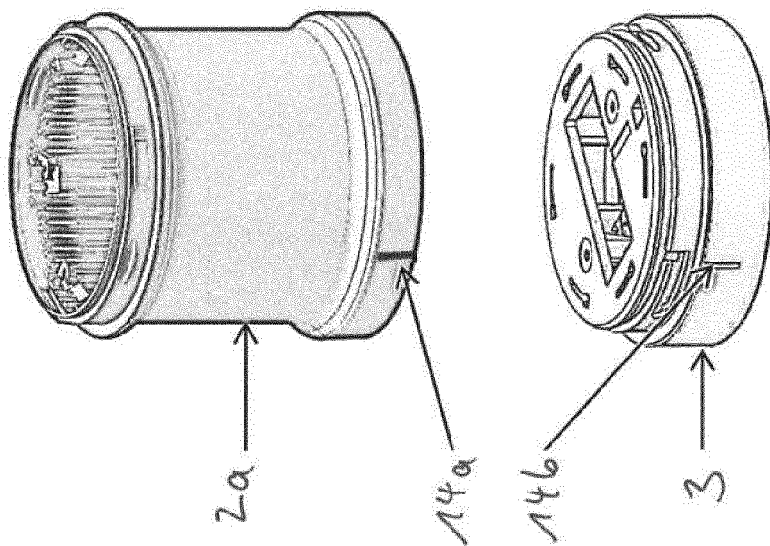
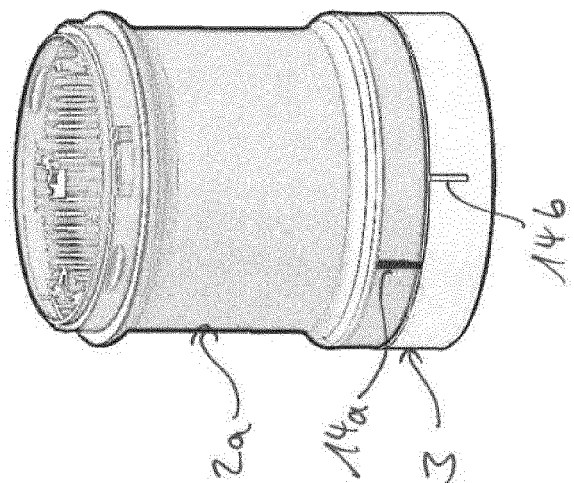


Fig. 4

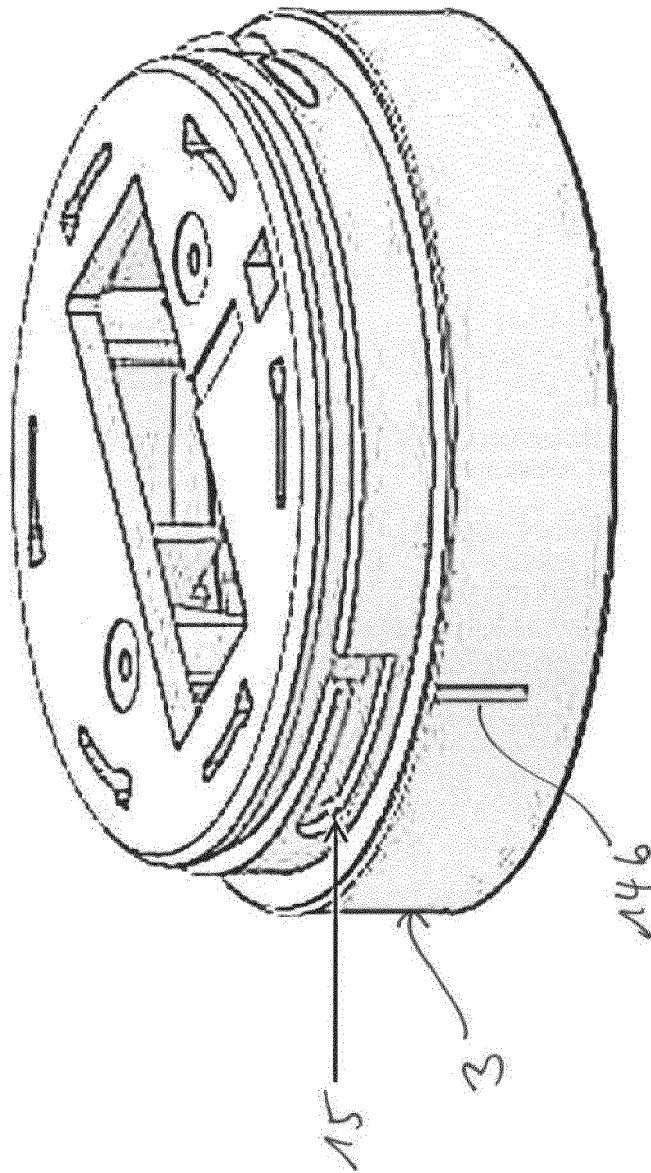


Fig. 7



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P : intermediate document		& : member of the same patent family, corresponding document	

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