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(71) Applicant *(for all designated States except US)*: **DOSSENA & C. S.N.C. DI BARBATI AGOSTINO & C.** [IT/IT]; Via Ada Negri, 1, I-26824 Cavenago d'Adda, LODI (IT).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **FARFARINI, Franco** [IT/IT]; Via Vanazzi, 2, I-26900 Lodi (IT). **BARBATI, Agostino** [IT/IT]; P.zza Martiri della Libertà, 1, I-26824 Cavenago d'Adda, LODI (IT). **BONACCORSO, Elena** [IT/IT]; Via Donatori sangue, 5, I-29020 Gossolengo, PIACENZA (IT).

(74) Agents: **PULIERI, Gianluca, Antonio** et al.; Jacobacci & Partners S.p.A., Via Berchet, 9, I-35131 Padova (IT).

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(54) **Title**: PLANT AND RELATIVE METHOD FOR THE DISTRIBUTED CONTROL OF LIGHTING, IN PARTICULAR FOR EXTERNAL ENVIRONMENT

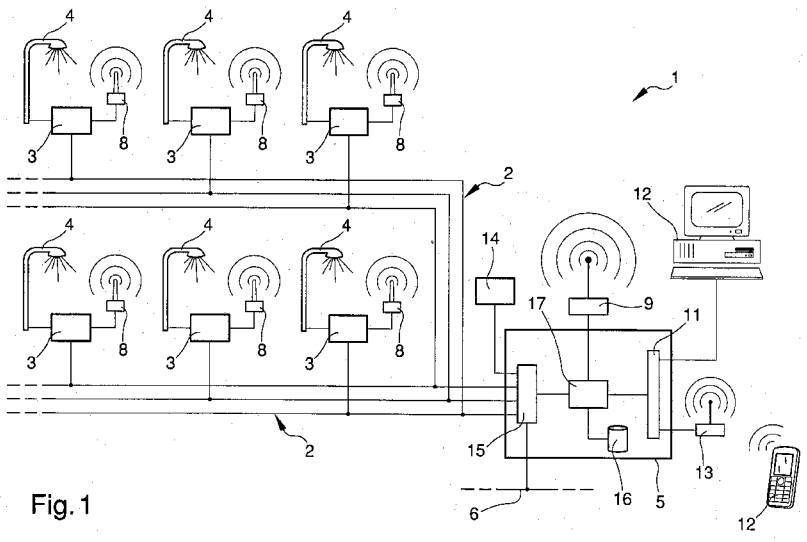


Fig. 1

(57) **Abstract**: A plant (1) and the relative method for the distributed control of lighting, in particular for lighting external environments. The plant (1) comprises at least one electric power supply line (2) provided with at least one pilot device (3) of a lighting appliance (4) of an environment, advantageously the pilot device (3) comprises at least one light intensity regulation unit (7) of said lighting appliance (4) during a work interval and starting from a regulation instant dynamically determined by means of an algorithmic calculation.

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DESCRIPTION

"PLANT AND RELATIVE METHOD FOR THE DISTRIBUTED CONTROL OF LIGHTING, IN PARTICULAR FOR EXTERNAL ENVIRONMENT"

[0001] The present invention refers to a plant and relative method for the distributed control of lighting, in particular for lighting exterior environments.

[0002] With specific reference to lighting exterior environments, it is known for plants to be used provided with at least one management and control ECU and a plurality of lamps distributed within the environment to be lit. Each of the lamps is connected to the ECU by the interposition of respective electronic devices for regulating the intensity of the power supply current, commonly known as "ballast".

[0003] The activation and deactivation of the lamps is managed by a light sensor connected to the management and control ECU that detects the intensity of the light in the environment to be lit.

[0004] Furthermore, the making of the lighting plant envisages that the installation of ballasts along the power supply lines, uphill of the respective lamps, and the transmission of control signals from the ECUs to the single ballasts, or vice versa, occurs using the so-called conveyed wave technique.

[0005] In practice, the transmission of signals is

performed along the same electricity supply lines, overlapping the power supply's electric current, direct or alternating at low frequency, a higher frequency modulated signal starting from the information to be transmitted.

[0006] However, the lighting plants of the known art present a number of drawbacks.

[0007] Specifically, the regulation of the activation and deactivation of the lamps by means of the light sensor and the use of the lamps for the entire duration of the night, regardless of the effective use of the lit environment, causes non-negligible electricity consumption.

[0008] Furthermore, the use of the same power supply line for the transmission of communication signals between the single ballasts and the management and control ECU, requires the installation of appropriate filters for signal selection that makes the plant installation operations more complex and that, in any case, do not guarantee a reduction in the interference caused by other electrical devices.

[0009] Another disadvantage of the plants of the known art is the considerable and unpredictable dispersion of energy on radio frequency frequencies during signal transmission through the power supply lines.

[0010] Furthermore the activation and deactivation of the lamps through the light sensor and use of the lamps for the entire duration of the night, regardless of the effective use of the lit environment, causes non-negligible electricity consumption.

[0011] The aim of this invention is to resolve the cited drawbacks of the known art.

[0012] Specifically, the main aim of the present invention is to devise a plant and relative method for the distributed control of lighting, specifically for the lighting of external environments, which makes it possible to considerably reduce energy consumption.

[0013] Another aim of the present invention is to devise a plant and relative method for the distributed control of lighting, specifically for the lighting of external environments, that is easy to install and guarantees, at the same time, a reliable transmission between the ballasts and the management and control ECU.

[0014] Another aim of this invention is to devise a plant and relative method for the distributed control of lighting, in particular for lighting external environments, that makes it possible to overcome the abovementioned drawbacks of the known art in a simple, rational solution that is easy and efficacious to use and has a limited cost.

[0015] Such drawbacks are resolved by a device according to claim 1 and by a method according to claim 33.

[0016] Other embodiments of this invention are described in the further claims.

[0017] Further characteristics and advantages of this invention will be further evident in the description of a preferred but not exclusive embodiment of a plant and relative method for the distributed control of lighting, in particular for external environments, such as illustrated by way of a non-limiting example with the aid of the appended drawings wherein:

[0018] figure 1 is a general diagram of a first embodiment of the plant according to the invention;

[0019] figure 2 is a general diagram of the pilot device of the plant in figure 1;

[0020] figure 3 is a general diagram of the pilot device in accordance with a second embodiment of the plant according to the invention.

[0021] With reference to the aforesaid figures, 1 indicates a plant for the distributed control of lighting, in particular for lighting external environments.

[0022] The plant 1 comprises one or more electrical power lines 2, each of which is fitted with a plurality of pilot devices 3 of respective lighting appliances 4,

constituted by high pressure sodium lamps (SAP), containing metal iodides or the like.

[0023] The plant 1 also comprises a management and control ECU 5 of the pilot device 3 placed between the electric power lines 2 and an external supply line 6.

[0024] Particularly, each of the pilot devices 3 comprises a regulation unit 7 for the electric power current of the lamp 4, and therefore of the lighting intensity released by the lamp itself. This regulation unit 7 is of the electric power supply regulation devices type commonly used and known as "ballast".

[0025] Advantageously, in a first embodiment of the finding illustrated in figures 1 and 2, each of the pilot devices 3 is associated with a radiofrequency communication unit 8 suited to transmitting/receiving a radiofrequency signal to/from a receiver/transmitter device 9 on to the management and control ECU 5.

[0026] Usefully, the communication unit 8 of each of the pilot device 3 is provided with a device for repeating the radiofrequency signal received towards one or more of the communication units 8 of the other pilot devices 3.

[0027] This allows the diffusion of the radiofrequency signal on to all the pilot devices 3 of the plant 1 also using relatively low power level signals.

[0028] The pilot device 3 is also fitted with a processing and control unit 10, of the microcontroller type or similar, placed between the communication unit 8 and the regulation unit 7.

[0029] The interfacing of the management and control ECU 5 with the operators (administrators or maintenance technicians) of the plant 1 takes place through a connection port 11 that can be connected, for example, with an external interface appliance 12.

[0030] The interface appliance 12 can be constituted, for example, by a local computer connected to the connection port 11 by cable or, alternatively, by a remote device such as a cell phone, hand-held computer or the like. In this latter case, the connection port 11 can be connected to an auxiliary device 13 for receiving/transmitting a radiofrequency signal, provided with a transmitter and/or a receiver operating in the frequency spectrum with mobile telephony protocols such as GSM, GPRS or the like.

[0031] Usefully, the management and control ECU 5 is connected to at least one light sensor 14, of the twilight relay type or the like, suited to detecting the intensity of the light within the environment for the management of the activation and deactivation of the lamps 4.

[0032] Usefully, each of the pilot devices 3, in particular the regulation unit 7, comprises means for verifying the status of the lamp 4. In particular, such means of verification make it possible to detect the aging status of the lamp and any abnormalities such as, for example, failure or exhaustion of the lamp, lamp intermittency or others still.

[0033] The management and control ECU 5 comprises a diagnostic unit and the instant for the regulation/protection of the electric power supply lines 2, indicated in figure 1 with the number 15.

[0034] In particular, the diagnostic and protection unit 15 may comprise a first device for detecting a short circuit on one of the electric supply lines 2, of the thermomagnetic circuit-breaker type or the like.

[0035] The diagnostic and protection unit 15 may also comprise, a second device for detecting electric dispersion along one of the electric power supply lines 2, that may be constituted, for example, by a differential relay or the like.

[0036] Usefully, the diagnostic and protection unit 15 can comprise a third device for detecting an electric overload and a fourth device for detecting a phase interruption on one of the electric power supply lines 2.

[0037] The diagnostic and protection unit 15 may also comprise a fifth device for detecting failure of the light sensor 14.

[0038] The management and control ECU 5 is provided with a storage unit 16, constituted by a non-volatile memory on which it is possible to save all the events concerning the diagnostics of the plant 1.

[0039] Advantageously, the regulation unit 7 for each of the pilot devices 3 reduces the light intensity of the respective lamp 4 starting from a regulation instant that is determined by an algorithmic calculation, so as to reduce electrical energy consumption during the night.

[0040] In particular, the management and control ECU 5 comprises means for determining 17 the aforesaid regulation instant, determined according to information such as the geographical coordinates of the plant 1 (or a group of lamps 4) and the light conditions during the specific period of the year. This makes it possible, for example, to start the reduction in light intensity of the lamps always at the same time of night, in any period of the year.

[0041] In particular, the light conditions during the specific period of the year can be calculated using an appropriate software algorithm and compared with the

variations in light detected by the light sensor 14.

[0042] Other useful parameters for the determination of the regulation instant can be, for example, previous regulation instants or previous work intervals of the lamps 4, intended as time intervals elapsing between the activation and deactivation of the lamps 4.

[0043] The means of determination 17 are constituted by a calculation unit, of the microprocessor or similar type, and the aforesaid information can be organised into appropriate tables and stored inside the storage unit 16. The information thus stored can be consulted and modified by an operator through use of the interface appliance 12.

[0044] Advantageously, the plant 1 may envisage a general control unit, not shown in the aforesaid figures, operatively associated to a plurality of management and control ECUs associated to respective groups of lamps 4.

[0045] In a second embodiment of the plant 1, as illustrated in figure 3, the pilot device 3 is connected to a manual setting device 18, of the trimmer type or similar, suited to setting at least one amongst the temporal instant of regulation, a delay interval of the activation and/or deactivation of said lighting appliance and the work power of said lighting appliance.

[0046] The processing and control unit 10 is therefore

positioned between the regulation unit 7 and the manual setting device 18.

[0047] In this case the regulation of the dimming of the light intensity of the lamp 4 is therefore performed manually by an operator at the time of installation, and the processing and control unit 10 manages the regulation unit 7 according to the settings made.

[0048] With reference to the first embodiment of the plant 1, the method according to the finding comprises the activation of one or more lamps 4 inside the environment at a preset switching on time and deactivation of the lamps 4 after a preset work interval. In particular, the activation and the deactivation of the lamps 4 is controlled by the light sensor 14.

[0049] Advantageously, the method envisages the regulation of the light intensity of the lamps 4, through the regulation unit 7 of the pilot devices 3, during the work interval and starting from a dynamically determined regulation instant.

[0050] Particularly, the regulation time can be determined by a calculation unit 17, according to the duration of the work interval, and starting from at least one of the pieces of information chosen from the set comprising: one or more previous regulation

instants, one or more previous work intervals, the geographic coordinates of the lamps 4, the light conditions of the environment in the specific time of year, specific time programmes chosen by the user.

[0051] This information is stored on the storage unit 16 ad can be consulted and modified by an operator accessing the plant 1 by means of the interface appliances 12.

[0052] The communication between the management and control ECU 5 and the pilot devices 3 takes place through the reception and transmission of radiofrequency signals and by means of the communication unit 8 and the receiver/transmitter device 9.

[0053] In particular, the management and control ECU 5 transmits to the communication unit 8 the management signals of the pilot device 3, which are subsequently transmitted to the regulation unit 7 by the processing and control unit 10. Similarly, the regulation unit 7 transmits any reports on the malfunction of the lamp 4 detected by the means of verification to the processing and control unit 10, reports that are subsequently sent to the management and control ECU 5 through the communication unit 8 and stored on the storage unit 16.

[0054] The diagnostic and protection unit 15, on the other hand, manages any malfunctions detected on the

power supply lines 2, subsequently stored on the storage unit 16.

[0055] Alternatively in the second embodiment of the finding, the method envisages the manual setting of the regulation instant, of a switch on delay interval and of advance of the switching off of the lamps 4, and of the working power of the lamps 4 by means of the manual setting device 18.

[0056] It has been practically proven that the described finding achieves the purposes set.

[0057] For example, the presence of means of regulation and determination of the regulation instant according to the duration of the work interval makes it possible to considerably reduce energy consumption.

[0058] Another advantage is given by the radio frequency communication between the management and control ECU and the pilot devices that simplifies plant installation and guarantees, at the same time, reliable transmission.

[0059] Another advantage is the presence of the means of regulation and determination of the regulation instant that can be parametrically preset by an operator or determined according to the duration of the previous work interval. In this way it is possible to obtain a considerable reduction in energy consumption.

[0060] A man skilled in the art, in order to satisfy contingent and specific requirements, will be able to make various modifications and variants to the plant and methods described above, all of which being within the scope of this invention as defined by the following claims.

CLAIMS

1. Plant for the distributed control of lighting (1), in particular for external environments, comprising at least one electric power supply line (2) fitted with at least one pilot device (3) of a lighting appliance (4) of an environment, characterised by the fact that said pilot device (3) comprises at least one light intensity regulation unit (7) of said lighting appliance (4) during a work interval and starting from a regulation instant dynamically determined by means of an algorithmic calculation.

2. The plant (1) according to claim 1, characterised by the fact that it comprises means of determination (17) of said regulation instant depending on the duration of said work interval.

3. The plant (1) according to claim 1 or 2, characterised by the fact that it comprises means of determination (17) of said regulation instant according to at least one of the pieces of information chosen from the set comprising: at least one previous regulation instant, at least one previous work interval, the geographic coordinates of the lighting appliances (4), the light conditions of said environment in the specific period of the year, specific time programmes chosen by

the user.

4. The plant (1) according to any one of the previous claims, characterised by the fact that it comprises at least one management and control ECU (5) of said pilot device (3).

5. The plant (1) according to any of claims 2 to 4, characterised by the fact that said means of determination (17) comprise at least one calculation unit of said management and control ECU (5).

6. The plant (1) according to claim 4 or 5, characterised by the fact that said management and control ECU (5) comprises at least one data storage unit (16).

7. The plant (1) according to claim 6, characterised by the fact that said data storage unit (16) is of the non-volatile memory type.

8. The plant (1) according to claim 6 or 7, characterised by the fact that said data storage unit (16) comprises at least one of the pieces of information chosen between the geographical coordinates, the light conditions in the specific period of the year, at least one of the previous regulation instants and at least one of the previous work intervals.

9. The plant (1) according to any of the previous

claims, characterised by the fact that said pilot device (3) is associated to at least one radiofrequency communication unit (8) suited to receiving/transmitting a radiofrequency signal from/to said management and control ECU (5).

10. The plant (1) according to claim 9, characterised by the fact that said pilot device(3)comprises at least one processing and control unit (10) positioned between said communication unit (8) and said regulation unit (7).

11. The plant (1) according to claim 9 or 10, characterised by the fact that said management and control ECU (5) is associated to at least one receiver/transmitter device (13) of a radiofrequency signal from/to said communication unit (8).

12. The plant (1) according to any one of the previous claims, characterised by the fact that it comprises a plurality of pilot devices (3) and respective lighting appliances (4).

13. The plant (1) according to any of the claims 9 to 12, characterised by the fact that at least one radiofrequency communication unit (8) associated to at least one repeater device of a radio frequency signal received towards at least one of the other communication units (8).

14. The plant (1) according to any of claims 4 to 13, characterised by the fact that it comprises at least one light sensor (14), associated to said management and control ECU (5).

15. The plant (1) according to claim 14, characterised by the fact that said light sensor (14) is of the twilight relay or similar type.

16. The plant (1) according to any one of the previous claims, characterised by the fact that said pilot device (3) comprises means for verifying the status of said lighting appliance (4).

17. The plant (1) according to any of claims 4 to 16, characterised by the fact that said management and control ECU (5) comprises at least one connection port (11) with at least one external interface appliance.

18. The plant (1) according to claim 17, characterised by the fact that said connection port (11) is associated to at least one auxiliary reception/transmission device (13) of a radiofrequency signal from/to said interface appliance (12).

19. The plant (1) according to claim 18, characterised by the fact that said auxiliary reception/transmission device (13) comprises at least one transmitter and/or receiver operating within the spectrum of frequencies with mobile telephone protocols.

20. The plant (1) according to claim 19, characterised by the fact that said mobile telephony protocols are GSM, GPRS or similar type protocols.

21. The plant (1) according to any of claims 4 to 20, characterised by the fact that said management and control ECU (5) is associated to said electric power supply line (2).

22. The plant (1) according to any of claims 4 to 21, characterised by the fact that said management and control ECU (5) comprises at least one diagnostic and protection unit (15) of said electric power supply line (2).

23. The plant (1) according to claim 22, characterised by the fact that said diagnostic and protection unit (15) comprises at least one first device for detecting a short circuit on said electric power supply line (2).

24. The plant (1) according to claim 23, characterised by the fact that said first detection device is of the thermomagnetic or similar type.

25. The plant (1) according to any of claims 22 to 24, characterised by the fact that said diagnostic and protection unit comprises at least one second device for detecting electricity dispersion on said electric power supply line (2).

26. The plant (1) according to claim 25, characterised by the fact that said second detection device is of the differential relay or similar type.

27. The plant (1) according to any of claims 22 to 26, characterised by the fact that said diagnostic and protection unit comprises at least one third device for detecting an electric overload on said electric power supply line (2).

28. The plant (1) according to any of claims 22 to 27, characterised by the fact that said diagnostic and protection unit comprises at least one forth device for detecting a phase interruption on said electric power supply line (2).

29. The plant (1) according to any of claims 22 to 28, characterised by the fact that said diagnostic and protection unit comprises at least one fifth device for detecting a failure of the light sensor (14).

30. The plant (1) according to any of claims 4 to 29, characterised by the fact that it comprises at least one general control ECU operatively associated to a plurality of said management and control ECUs (5).

31. The plant (1) according to any of the previous claims, characterised by the fact that said pilot device (3) is associated to at least one device for the manual setting (18) of at least one amongst said regulation

instant, the activation and/or switching off delay of said lighting appliance, the working power of said lighting appliance (4).

32. The plant (1) according to claim 31, characterised by the fact that said pilot device(3)comprises at least one processing and control unit positioned between said manual setting unit (18) and said regulation unit (7).

33. Method for the distributed control of a lighting system according to any of claims 1 to 32, comprising an activation phase of at least one lighting appliance (4) of an environment at a preset activating instant and a deactivation phase of said lighting appliance (4) after a preset work interval, characterised by the fact that it comprises a regulation phase of the light intensity of said lighting appliance (4) during a work interval and starting from a regulation instant determined by means of an algorithmic calculation.

34. The method according to claim 33, characterised by the fact that it comprises a phase of determination of said regulation instant according to the duration of said work interval.

35. The method according to claim 33 or 34, characterised by the fact that said regulation instant is parametrically pre-programmed and/or determined depending on at least one of the pieces of information

selected from the set comprising: at least one previous regulation instant, at least one previous work interval, the geographic coordinates of said lighting appliance (4), the light conditions of said environment in the specific period of the year.

36. The method according to any of the claims from 33 to 35, characterised by the fact that it comprises the storage of at least one of the pieces of information chosen from the group comprising: at least one previous regulation instant, at least one previous work interval, the geographic coordinates of said lighting appliance, the light conditions of said environment in the specific period of the year.

37. The method according to any of the claims from 33 to 36, characterised by the fact that it comprises the consultation and modification of said information.

38. The method according to any of the claims from 33 to 37, characterised by the fact that it comprises the manual setting of at least one amongst said regulation instant, a switch on delay interval and advance of switching off of said lighting appliance (4), the working power of said lighting appliance (4).

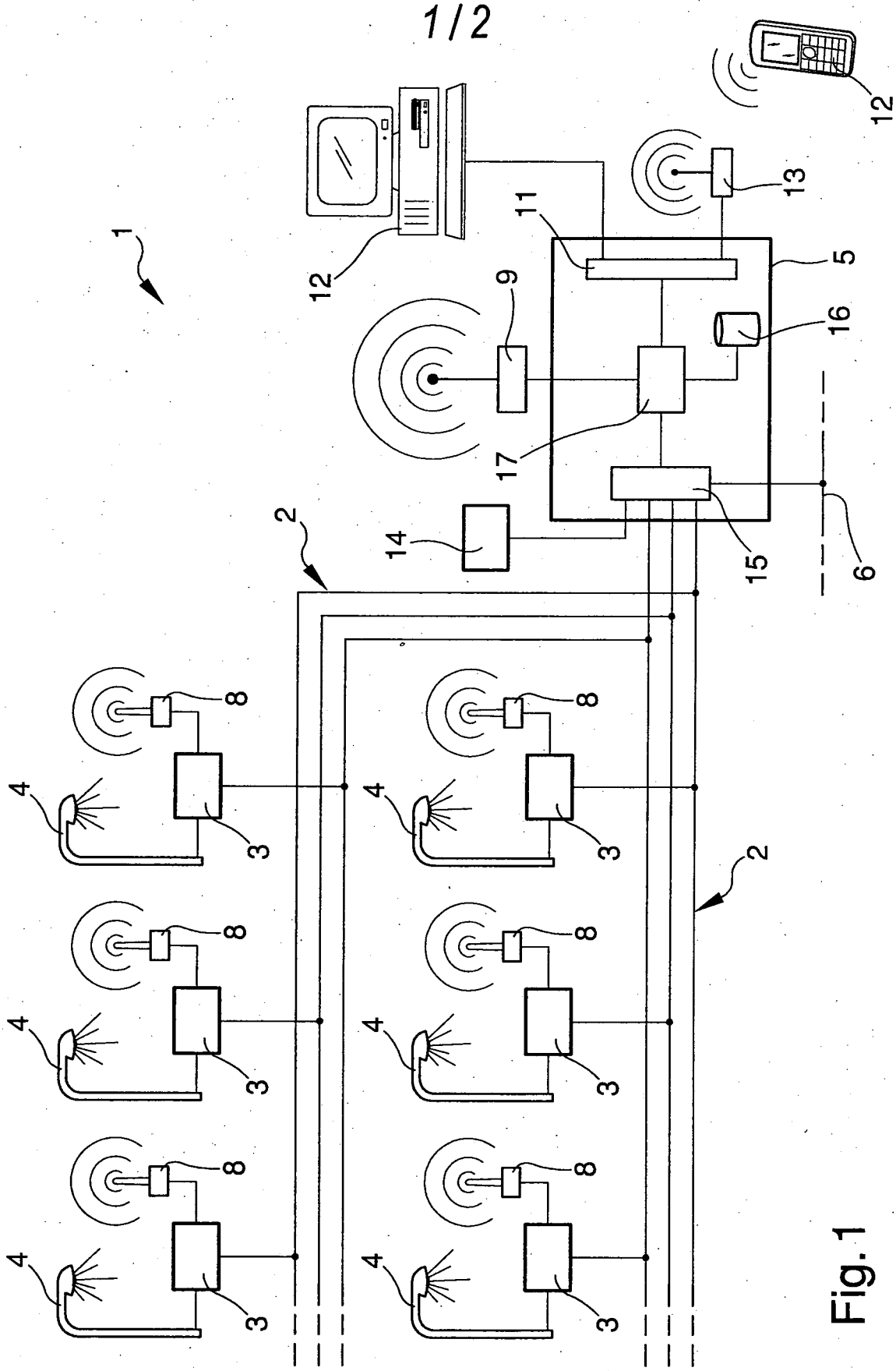


Fig. 1

Fig. 2

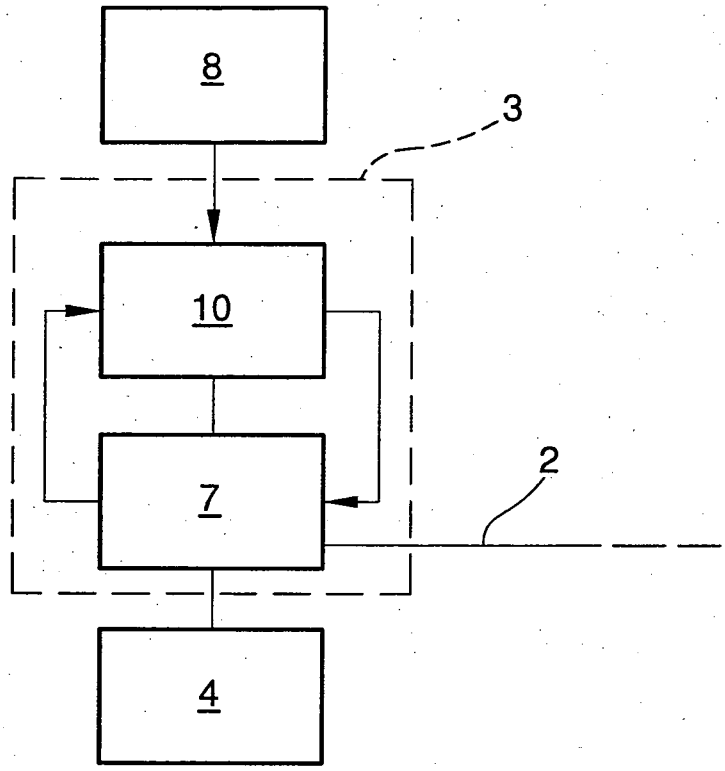
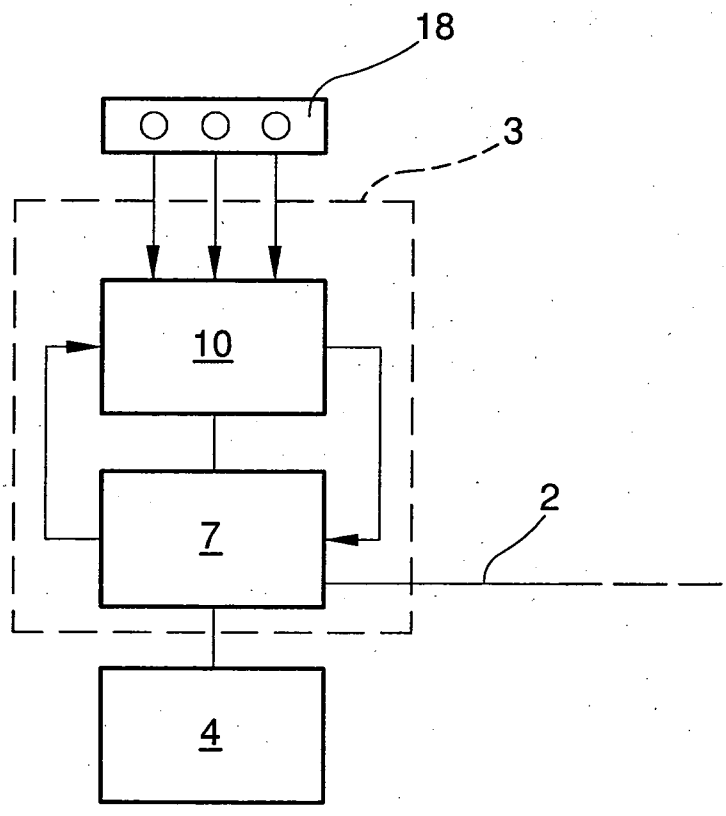


Fig. 3



INTERNATIONAL SEARCH REPORT

International application No
PCT/IT2008/000797

A. CLASSIFICATION OF SUBJECT MATTER
INV. H05B37/02

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)
H05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	US 5 936 362 A (ALT LARRY G [US] ET AL) 10 August 1999 (1999-08-10) column 1, lines 32-38 column 2, lines 47-54 column 3, lines 7-27 column 3, lines 62-66 column 4, lines 1-20 column 5, lines 9-14 figure 2	1-38

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

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
24 June 2009	13/07/2009

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	Benedetti, Gabriele

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INTERNATIONAL SEARCH REPORT

International application No
PCT/IT2008/000797

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

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